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The Tylostomaceae of North America

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(WITH PLATES 31–40)

The members of this family are puffball-like plants, which form underground in the shape of rounded masses, appearing at first on the mycelium as minute thickenings, and gradually reaching their full development. The ball has a thick outer covering, and an inner, and usually thinner one, commonly known as the peridium proper. The upper and larger portion of the ball is composed of sporogenous tissue, and there is a lower sterile portion which elongates when conditions are most favorable, forcing the upper portion up through the surface of the ground, and consequently rupturing the outer coat which originally enveloped the whole mass. In some genera this outer coat remains at the base as a distinct cup-like volva, the upper portion then being carried up almost intact and falling away or adhering to the peridium ; in other cases the outer coat is ruptured irregularly, bearing very slight traces at the base of the stem or even none at all, and in the genus *Tylostoma* this coat adheres more or less to the peridium, nearly always leaving some traces in the form of a collar at its base. The stem is commonly of a firm, almost woody texture, and the plants can be quite satisfactorily preserved in a dry condition. They vary greatly as to size and shape, but are all constructed on the same general plan, having a more or less irregularly globose peridium, and a distinct footstalk, which is usually, though not always, more than twice the length of the peridium in mature forms. The methods of

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dehiscence are very different in the various genera, some having a definite apical mouth, the peridium withering and collapsing as the spores escape; others rupture irregularly from above downwards, more as in the Sclerodermataceae. *Battarrea* has a regular line of dehiscence where the upper portion of the somewhat hemispheric peridium breaks away, leaving the lower portion at the summit of the long stem.

In the peridial characters, *Tylostoma* is closely allied to the Lycoperdaceae. The relation of this family to the Phallaceae is one of analogy mainly, shown in the elongation of the stem which forces the spore-bearing parts to a higher position for the better scattering of the spores.

In his latest treatment of the family, Fischer* recognizes four genera: *Tylostoma* with forty species, widely distributed; *Queletia* with a single species from France, failing to note that it had also been reported from America; *Battarrea* with eight species; and *Sphaericeps* with one species from Angola. The genus *Chlamydopus*, described by Spegazzini† from Argentina, after Fischer's first draft was prepared, was later too summarily assigned as a synonym of *Tylostoma*,‡ for the differences are so marked that it would be unfortunate to include these two diverse types under one genus.

Within the past year several specimens of a *Chlamydopus* have been found at Mesilla Park, New Mexico, and it was the original purpose of this paper simply to describe and figure these. It soon became necessary to study the members of the allied genus *Tylostoma*, of which extensive suites of specimens were found in the Ellis collection, mainly from the western half of the country, representing some species hitherto undescribed, so that it was finally concluded to prepare a revision of the entire family as represented in North America. Finally some specimens collected by Mr. E. Bethel, of Denver, Colorado, and sent by him to Mr. Ellis, proved to belong to an undescribed genus. This large amount of material, mostly forming a part of the Ellis collection at the New York Botanical Garden has made the preparation of this paper

* Engler & Prantl, Die nat. Pflanzenfam. 1^{1**}: 342. 1900.

† An. Mus. Nac. Buenos Aires, 6: *pl. 4. f. 2, 3.* 189. 1899.

‡ Engler & Prantl, Die nat. Pflanzenfam. 1^{1**}: 357. 1900.

possible. Mr. E. Bartholomew has kindly loaned material, for the better description of one species, and Mr. E. S. Salmon has kindly looked up some data at Kew, England.

Special thanks are due to Professor Charles H. Peck, of Albany, for material and suggestions, and more especially to Professor L. M. Underwood, of Columbia University, under whose direction the work has been undertaken and whose private collection has furnished considerable additional material.

The genera of the family Tylostomaceae may be recognized by the following synopsis:

Peridium opening by an apical mouth.
- Peridium with a collar underneath, formed about the cylindrical stem; volva indefinite. I. TYLOSTOMA
- Peridium without a collar; stem much enlarged where it joins the peridium; volva cup-like, flaring. II. CHLAMYDOPUS

Peridium circumscissile.
- Peridium hemispheric or nearly plane below, dehiscing at the margin of the plane of the hemisphere. III. BATTARREA
- Peridium spherical, dehiscing at the equator. SPHAERICEPS (extra-limital).

Peridium opening irregularly.
- Peridium readily separating from the stem; capillitium free. IV. QUELETIA
- Peridium closely attached to the stalk; capillitium embedded in a membranous tissue. V. DICTYOCEPHALOS

I. TYLOSTOMA Pers. Römer, Neues Mag. Bot. 1: 86. 1794

The first reference to a plant certainly belonging to *Tylostoma*, is to be found as early as 1696, in Ray's Synopsis * under the name of *Fungus pulverulentus minimus*. He describes it in a few Latin words, "Pediculo longo, insidens. In agris circa Londinum," and adds in English, "the least dusty mushroom, with a long foot-stalk, collected by D. Tancred Robinson, M.D." The next mention is made in 1700 by Tournefort † who also gives the first figure of a *Tylostoma*; this has the characteristic short tubular mouth of *T. pedunculatum*, a slender, smooth stem, and closely resembles specimens of this plant found in our own country. Micheli ‡ next figured the other variety of *T. pedunculatum* under the name, *squamosum*. This figure is not so easy to identify as that of Tournefort;

* Syn. Meth. Stirp. Brit. 2d ed., 16. 1696.

† Inst. rei Herb. 1: 563. *pl. 331. f. E, F.* 1700.

‡ Nova Plantarum Genera, 218, nos. 10 and 11. *pl. 97. f. 1.* 1729.

none of the European specimens of this variety seen, have such a rough stem, or a peridium of the exact shape as shown in the figure, but it is evident notwithstanding, what it was meant to represent. *T. pedunculatum* being the commonest European species, and widely distributed tends to vary and extreme specimens are found to differ so widely that were it not for the many intermediate stages, the extremes might well be kept distinct, as indeed has been done by several writers.

Linnaeus* refers to this same plant by its first binomial, *Lycoperdon pedunculatum*, and cites the above-mentioned descriptions of Ray and Tournefort. His description is in the following words: "Stipite longo, capitulo globoso glabro; ore cylindrico, integerrimo. Habitat in campestribus." In 1794 Persoon established the genus *Tulostoma.*† He described it—"Peridium stipitatum, ore cylindrico cartilageneo"—and mentions two species *T. brumale* (*L. pedunculatum* L.) and *T. imbricatum* (Micheli Ly. 11); these two species have since been commonly referred to, under the name of *T. mammosum* (Mich.) Fries, but all these specific names are antedated by *pedunculatum* of Linnaeus.

Since the time of Persoon, various species of *Tylostoma* have been described, and De Toni‡ enumerates thirty-four species from different parts of the world.

Our own species were studied in 1890 by Morgan,§ but evidently from a limited amount of material. In his paper he enumerates five species, of which *T. mammosum* and *T. fimbriatum* are originally European, two were new native species, *T. verrucosum* and *T. campestre*, and the fifth he called *T. Meyenianum* Kl., but it is evident that the original *T. Meyenianum* was not a true *Tylostoma* but a poorly figured species of the genus *Chlamydopus*, and as the material on which Morgan based his determination is not now available, we are uncertain as to what his last species really is. *T. pedunculatum* was first reported from this country in 1818 by Schweinitz‖ under the name

* Sp. Plant. 1184. 1753.

† Tylostoma from τυλοσ, callous skin, and στομα, a mouth.

‡ Saccardo, Syll. Fung. 7: 60; 9: 268; 11: 159; 14: 258.

§ Jour. Cin. Soc. Nat. Hist. 12: 163; *pl. 16. f. 1–5.* 1890.

‖ Syn. Fung. Car. 34. 1818.

of *T. brumale* Pers. from North Carolina, and in 1834* he gives two species, *T. brumale* and *T. squamulosum*,† of which latter he writes "not a variety of the preceding but closely resembling *Rinella* of Rafinesque,‡" but notwithstanding his assertion to the contrary *T. squamosum* is now commonly regarded as a variety of *T. pedunculatum* (*brumale*). In 1837, Montagne§ described *T. exasperatum* from Cuba, collected by Ramon de la Sagra, the well-known Cuban naturalist, and this species has since been reported from India. In 1867 Curtis¶ mentions *T. fimbriatum* and *T. mammosum* as "common in North Carolina," and six years later Berkeley** reported *T. fimbriatum*, *T. mammosum*, and *T. Meyenianum*, collected by Wright in New Mexico. As late as 1891, Massee†† published Berkeley's description of *T. Wrightii*, also from New Mexico. Other American species have been described since, *T. obesum* C. & E.,‡‡ *T. punctatum* Peck, §§ and *T. semisulcatum* Peck. ¶¶ Much of the western material found in the Ellis collection had been referred to *T. obesum*, although it represents very diverse forms. *T. punctatum* has been reported from several localities, but of *T. semisulcatum* only the type specimens are known, and these are inaccessible at Albany, if indeed they are still in existence. Extensive collections have been made in different parts of the United States in the past few years and we

* Trans. Amer. Phil. Soc. **4**: 256. 1834.

† Since writing the above it has been possible to examine Schweinitz' original specimens, which are carefully preserved in the Philadelphia Academy of Natural Sciences. There is a question as to the specimen marked *T. brumale* being *T. pedunculatum*, to which it is usually referred, owing to the color of the peridium, which is a bright terra-cotta red, unlike anything seen before—but this may be due to the color of the clay in which the plant grew or to other causes of unknown origin. The specimen marked *T. squamosum* resembles greatly some of our specimens of *T. fimbriatum* in general habit and spore characters, with the exception of the mouth which is entire, but not tubular and prominent, like the mouth of *T. pedunculatum*—which fact may be owing to the wasting of the cartilaginous tissues occasioned by time—so that it is hardly possible to determine what this plant really was.

‡ Syst. F. Veg. 139.

§ Ann. Sci. Nat. II. **8**: 362. 1837.

¶ Geol. and Nat. Hist. Survey North Carolina, **3**: 110. 1867.

** Grevillea **2**: 49. 1873.

†† Grevillea **19**: 95. 1891.

‡‡ Grevillea **6**: 82, *pl. 100. f. 24*. 1878.

§§ Bull. Torr. Club, **23**: 419. 1896.

¶¶ Bull. Torr. Club, **22**: 209. 1895.

find among them several additional species. The indications are that we are only at the beginning of our knowledge of their distribution.

The following table shows the distribution of the hitherto known species of *Tylostoma*:

TYLOSTOMA.	North America.	South America.	Europe.	Asia.	Africa.	Australia.	Mexico and Central America.	Borneo.	Sandwich Islands.
album.						+			
Angolense.				+	+				
Barlae.			+						
Barbeyanum.				+					
Berteroanum.		+							
Bonianum.				+					
Bossieri.					+				
campestre.	+								
caespitosum.				+					
carneum.					+				
Cesatii.				+					
exasperatum.	+			+					
fimbriatum.	+		+			+			
Giovanellae.			+						
granulosum.			+						
Jourdani.					+				
laceratum.					+				
leprosum.						+			
Leveilleanum.									+
mammosum.	+		+	+	+	+	+		
maximum.						+			
Mollerianum.					+				
montanum.					+				
obesum.	+								
pulchellum.					+				
pusillum.		+						+	
Patagonicum.		+							
Schweinfurthi.					+				
squamosum.					+				
tortuosum.					+				
volvulatum.				+					
verrucosum.	+								
Wightii.				+					
Wrightii.	+								

The species of *Tylostoma* are found principally in sandy regions, in dry barren fields, rarely in woods or shaded places. As yet very little is known of their habits, growth and development as no little difficulty attends the study of these strange and interesting plants in their early subterranean stages. It is hoped that stu-

dents in the districts where these plants are most common will gather material in the earlier stages of growth—digging down where mature forms are found above ground in the hope of finding the young peridia.

As far as can be ascertained, only two papers have appeared treating of the growth of these plants. Schroeter * has published an account of the development of the spores and basidia. Professor Bessey † has a short note on the growth of *T. mammosum* in which he says, "The ball forms underground, and reaches maturity there so far as the spores are concerned. *Tylostoma* agrees with *Lycoperdon* in having the interior of the ball composed of two portions, first a spore-bearing part which occupies most of the interior, and second a sterile base composed of tissue which does not produce spores. In *Tylostoma* a portion of this tissue of the sterile base remains living until the spores ripen. Then this tissue begins a rapid growth and a cylindrical stalk is produced which forces the ball through the overlying earth and carries it up several inches." Massee,‡ speaking of *Tylostoma mammosum* says, "resembling a *Lycoperdon* with an elongated stem, but readily distinguished by the groove between the apex of the stem and the peridium, and by the threads of the capillitium being nodulose at the base of the septa." And writing of the stem, "it is sometimes smooth, and at others broken with small irregular fibrillose squamules which are sometimes arranged more or less in circles."

Synopsis of our Species

Mouth entire, short tubular.
  Spores smooth, or occasionally with a few minute scattered warts.
    1. *T. albicans.*
  Spores uniformly and densely verrucose.
    Peridium smooth; capillitium not much swollen at the joints.
      2. *T. pedunculatum.*
    Peridium warty; capillitium swollen at the joints. 3. *T. verrucosum.*
Mouth lacerate-fimbriate, not tubular.
  Spores smooth or nearly so.
    Mouth plane.
      Stem tapering toward the base; peridium depressed.
        4. *T. gracile.*

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* Cohn's Beitr. Biol. Pflan. **2**: 65. 1877.

† Amer. Nat. **21**: 665. 1887.

‡ Ann. Bot. **4**: 85. 1889.

Stem not tapering; peridium globose.
Capillitium freely septate; stem short (1–1.5 cm.), collar close. 5. *T. minutum.*
Capillitium rarely or never septate; stem longer (1.5–5 cm.), collar distant. 6. *T. Kansense.*
Mouth raised, convex.
Capillitium freely septate; outer peridium long persistent. 7. *T. poculatum.*
Capillitium rarely or never septate; outer peridium soon receding. 8. *T. obesum.*
Spores verrucose or granular.
Mouth plane. 9. *T. campestre.*
Mouth raised, convex.
Spores furnished with long blunt spinules; stem short (0.75 cm.), rough spiny. 10. *T. exasperatum.*
Spores with coarse scattered tubercles; stem longer (3 cm.), even, nearly smooth. 11. *T. tuberculatum.*
Spores finely granulate-verrucose.
Capillitium sparingly septate, not much swollen at the joints.
Stem elongate (6 cm.), with copious persistent mycelial strands. 12. *T. fibrillosum.*
Stem shorter (3.5 cm.), without mycelial strands. 13. *T. subfuscum.*
Capillitium freely septate, swollen at the joints.
Peridium smooth; mouth fimbriate. 14. *T. fimbriatum.*
Peridium pitted; mouth lacerate. 15. *T. punctatum.*

1. **Tylostoma albicans** sp. nov.

Peridium depressed globose, 0.7–1 cm. high, 1–1.5 cm. in diameter: outer peridium scaly, retreating and leaving a smooth whitish surface to the inner membranaceous peridium: mouth short tubular, entire, prominent: collar irregular, 3–5 mm. distant from the stem: stem equal, slightly thickened at the base, the outer coating lacerate scaly, whitish like the peridium, 4–6 cm. long, 0.5 cm. in diameter: capillitium whitish, hyaline, branched, septate, slightly swollen at the joints, 4–6 μ wide, free ends rounded: spores reddish brown, irregularly globose, pedicled, smooth, or if rough only a very few of them so, 4–5 μ in diameter. (Pl. 31, f. 4–7.)

TEXAS: *E. D. Cope.*

2. TYLOSTOMA PEDUNCULATUM (L.) Schroeter; Cohn, Beitr. Biol. Pflan. **2**: 65. 1877

Lycoperdon pedunculatum L. Sp. Pl. 1184. 1753.

Tulostoma brumale Pers. Römer Neues Mag. Bot. **1**: 86. 1794.

Tulostoma mammosum Fr. Syst. **3**: 42. 1829.

Lycoperdon II. Mich. Nov. Plant. Gen. 218. 1729.

Tulostoma imbricatum Pers. Römer Neues Mag. Bot. **1**: 86. 1794.

Lycoperdon squamosum Gmel. Syst. Nat. **2**: 1462. 1796.

Tulostoma squamosum Pers. Syn. Meth. Fung. 139. 1801.

Tulostoma mammosum Fr. Syst. **3**: 42. 1829.

Tylostoma mammosum var. *squamosum* De Toni; Saccardo, Syll. Fung. **7**: 61. 1888.

Peridium subglobose, 1–1.5 cm. high, 1–2 cm. in diameter, the brown outer peridium soon retreating, leaving the inner peridium smooth and membranaceous: mouth short tubular, entire, prominent: collar inconspicuous: stem slender, lacerate scaly, or nearly smooth, with a small mycelial bulb, stuffed with loose silky threads, 1–5 cm. long, 2.5 mm. in diameter: capillitium 4–7 μ thick, septate, somewhat swollen at the joints, light colored, hyaline: spores subglobose, 3–5 μ in diameter, minutely verrucose, some short pedicled. (Pl. 31, f. 1–3.)

Exsicc. E. & E. N. A. Fungi 2734 (as *T. mammosum*). Ravenel, Fungi Am. Ex. 137 (as *T. mammosum*).

NEW YORK, *Underwood, Fischer;* NEW JERSEY, *Ellis;* PENNSYLVANIA; MICHIGAN, *McBride;* WISCONSIN, *D. V. B;* NORTH CAROLINA, *Curtis, Wood;* KANSAS, *Kellerman*, 770; INDIANA, *Cook, Underwood;* FLORIDA, *Underwood;* NEBRASKA, *Webber;* TEXAS, *Harris;* COLORADO; IOWA; NEW MEXICO, *Wright, Fendler, Cockerell;* MEXICO, *C. L. Smith.*

3. TYLOSTOMA VERRUCOSUM Morg. Jour. Cin. Soc. Nat. Hist. **12**: 163. *pl. 16. f. 2.* 1890

Peridium depressed globose, 1–1.2 cm. high, 1–1.5 cm. in diameter: outer peridium of scales and warts persistent: inner peridium brownish, becoming smooth with age: mouth entire, raised, prominent, short tubular: collar of delicate lacerate points descending about the top of the stem: stem 4–5 cm. long, .5 cm. in diameter, slender, the surface lacerate scaly, brown, hollow, cylindrical and having a large basal bulb composed of the mycelial strands and adherent earth: capillitium almost white, hyaline, slender, septate, some of the joints rather swollen, 3–6 μ wide: spores subglobose, granular, lightish cinnamon-colored, 4–7 μ in diameter. (Pl. 31, f. 8–10.)

OHIO: *Morgan, C. G. Lloyd.*

Growing on the ground in rich soil in woods. The mycelial bulb is usually larger than the peridium.

4. **Tylostoma gracile** sp. nov.

Peridium depressed globose, 1–1.5 cm. high, 1.5–2 cm. in diameter: outer peridium retreating, leaving but slight traces on the inner peridium which is thin, smooth, whitish and rather shiny: mouth plane, lacerate: collar entire, restricted around the top of the stem: stem slender, 3–5.5 cm. long, 6 mm. in diameter at the top, 3 mm. in diameter at the base which is slightly enlarged, somewhat sulcate, lacerate, whitish within and without, fibrillose stuffed, becoming hollow: capillitium dark ferrugenous, 4–6 μ wide, ends rounded, and having swollen places mostly near the ends, branched, rather thick-walled, many threads flattened, septa very scarce: spores subglobose, 3–5 μ in diameter, smooth, short pediceled. (Pl. 32, f. 1–3.)

NEW MEXICO: Las Cruces, *Wooton*.

5. **Tylostoma minutum** sp. nov.

Peridium globose, 0.7–1 cm. high, 0.7–1.2 cm. in diameter; outer peridium scaly, retreating, leaving smooth, brownish surface to the thin inner peridium, remnants of the outer peridium forming a cup around the base of the inner peridium: mouth plane, fimbriate, small; collar entire, indistinct: stem 1.5–2 cm. long, 3 mm. in diameter at the top, 5 mm. in diameter at the base, slender, slightly enlarged at the base, hollow, fibrillose stuffed: capillitium yellowish, hyaline, sparingly branched, rather thin walled, ends rounded, septa swollen at the joints, 3–5 μ wide: spores irregularly globose, nearly smooth, pediceled, thick-walled, 3–5 μ in diameter. (Pl. 31, f. 11–13.)

COLORADO, *Bethel* (type); KANSAS, *Kellerman*.

6. **Tylostoma Kansense** Peck, sp. nov.

Peridium subglobose, 1–2 cm. broad, 1–1.5 cm. high, thick, firm, glabrous, white, somewhat flattened at the base: mouth slightly lacerate on the margin, plane, sometimes slightly prominent: collar wide, membranaceous, 2.5 mm. distant from the stem: stem equal or slightly narrowed toward the base, 1.5–7 cm. long, 6–8 mm. thick, hollow or stuffed with silky fibrils, somewhat sulcate-striate, white within and without, slightly and abruptly bulbous: capillitium sparingly branched, colored, 7–11 μ wide, hyaline, septa not seen: spores subglobose, 4–5 μ in diameter, brownish ferruginous. (Pl. 32, f. 7–9.)

KANSAS, *Bartholomew*. July. It has rarely two ostiola.

7. **Tylostoma poculatum** sp. nov.

Peridium globose, somewhat depressed, 1–1.5 cm. high, 1–2 cm. in diameter, smooth, fawn-colored, membranaceous: outer peridium scaly, but more persistent than in most species, remaining in the shape of a cup-like involucre round the base of the peridium, mouth slightly raised, fimbriate, mostly large: collar entire, inconspicuous: stem 1–3 cm. long, 3–6 mm. in diameter, cylindrical, firm, slightly bulbose, hollow or stuffed, often with considerable remnants of the outer peridium attached: capillitium lightish yellow, sparingly branched, septate, swollen at joints, 4–7 μ wide, rather thick walled: spores ferruginous, subglobose, smooth, or irregularly ridged in the older specimens, owing to the shrinking of the inner substance, short pediceled, 4–5 μ in diameter. (Pl. 34, f. 4–6.)

NEBRASKA: Lone Pine, *Bates*, 462 (type); ALABAMA: Tuskegee, *Carver;* COLORADO: Boulder, *D. M. Andres.* Plants growing singly or in groups of twos and threes.

8. TYLOSTOMA OBESUM C. & E. Grevillea **6**: 82. *pl. 100. f. 24.* 1878

Peridium globose pyriform, 2.2 cm. high, 2 cm. in diameter, smooth, leathery, whitish, with a kid-like finish: outer peridium scaly, retreating, leaving a narrow ring around the lower part of the peridium: collar entire, descending about the stem: mouth raised, lacerate, rather large: stem 4 cm. long, hard, leathery, somewhat sulcate, slightly tapering at the base, 8 mm. in diameter at the top, 5 mm. in diameter at the base: capillitium dark ferruginous, slender, free ends rounded, branched, septa none or very scarce, 3–6 μ wide: spores globose, smooth, short pediceled, 3–6 μ in diameter. (Pl. 32, f. 4–6.)

COLORADO.

This description and the figure are based on the specimen of this species which Mr. Ellis retained when he sent other specimens to M. C. Cooke for a description. It will be seen that the dimensions and shape here given differ considerably from the one figured in Grevillea. The type is at Kew (2715 Cke.), and through the kindness of Mr. E. S. Salmon, it was possible to compare some of the spores and capillitium which agree in all respects with the original here, but the Kew specimens are apparently not so mature.

9. TYLOSTOMA CAMPESTRE Morg. Jour. Cin. Soc. Nat. Hist. **12**: 163. *pl. 16. f. 4.* 1890

Peridium subglobose, 1–1.5 cm. high, 1–2 cm. in diameter: outer peridium brown, scaly, retreating and leaving an irregular ring around the lower part of the smooth inner peridium: collar irregular, descending about the top of the stem: mouth plane, lacerate, in some specimens being a mere crack or slit: stem rather thick, 3–10 cm. long, 1–1.5 cm. in diameter, darker than the peridium, fibrillose stuffed, becoming hollow, outer brownish coat lacerate, scaly, and having a small thickened mycelial bulb: capillitium yellowish, hyaline, cylindrical, 4–8 μ wide, branched, septate, somewhat swollen at the septa: spores subglobose, warty, some short pedicled, 3–5 μ wide. (Pl. 33, f. 10–12.)

EXSICC: E. & E. N. A. Fungi, 3297 (as *T. granulosum* Sw. ?), 3514.

NEBRASKA: *Webber, Bates;* CALIFORNIA: *Underwood, McClatchie;* COLORADO, *Crandall.* Growing singly and in groups in sandy soil.

10. TYLOSTOMA EXASPERATUM Mont. Ann. Sci. Nat. II. **8**: 362. 1837

Peridium subglobose, 1.2 cm. high, 1.3 cm. in diameter: outer peridium composed of long spinulose scales, somewhat reflexed, which recede from the top downward, leaving the brown inner peridium marked with a series of regular pits: mouth raised, fimbriate lacerate, rather large: collar inconspicuous: stem equal, slightly enlarged at the base, 5–7 mm. in diameter, 3.5 cm. long, covered with reflexed lacerate scales, like those on the outer peridium: dark brown: capillitium whitish-yellow, hyaline, 4–6 μ wide, branched, free ends rounded, sparingly septate, not much swollen at the joints: spores globose, furnished with long blunt spinules, 5–8 μ in diameter. (Pl. 33, f. 1–3.)

CUBA, *Wright.*

11. **Tylostoma tuberculatum** sp. nov.

Peridium depressed globose, 1–1.2 cm. high, 1–1.8 cm. in diameter: outer peridium scaly, retreating, leaving a wide band around the base of the whitish, smooth, and rather thin, inner peridium: mouth raised, fimbriate, roundish: collar close, inconspicuous: stem slender, whitish, hollow or stuffed, slightly enlarged at the base, 2–3 cm. long, 3 mm. in diameter: capillitium light yellow, hyaline, branched, thick-walled, variable as to width, 4–8 μ wide, rather flattened, ends rounded, broad, sparingly sep-

tate, swollen at joints: spores subglobose, nearly smooth or with occasional tuber-like warts, thick-walled, 3–5 μ in diameter. (Pl. 33, f. 7–9.)

BRITISH COLUMBIA: *Macoun* (type); COLORADO: Fort Collins, *Baker*, 405.

12. **Tylostoma fibrillosum** sp. nov.

Peridium globose, 1–2 cm. high, 1–2.5 cm. in diameter: outer peridium retreating leaving a smooth whitish surface to the thin, membranaceous inner peridium, and leaving a thick portion round the base of the peridium forming a ring: collar indistinct, close: mouth raised, fimbriate, roundish: stem equal or slightly tapering toward the base, sulcate, firm, white and slimy within and without, somewhat hollow, fibrillose stuffed, and having a small thickened bulb which in some specimens falls off leaving a flat, whitish surface to the base of the stem, 5–7 cm. long, 5 mm. in diameter: capillitium whitish, hyaline, 4–8 μ wide, branched, some threads rather thicked walled, sparingly septate, not much swollen at the joinits, rather flattened: spores subglobose, minutely warted, darker than the capillitium, some short pediceled, 3–5 μ in diameter. (Pl. 33, f. 4–6.)

ONTARIO: *Dearness* (type); MICHIGAN, *Hicks*. Growing on sand dunes.

The stem is much covered usually for upwards of 2 cm. with the mycelial strands, and adhering sand. The specimens from Michigan have rather more swollen septa.

13. **Tylostoma subfuscum** sp. nov.

Peridium globose, 0.8–1.3 cm. high, 1–1.5 cm. in diameter: outer peridium scaly, retreating, leaving a ring around the base of the smooth, brownish inner peridium: mouth raised, fimbriate: collar inconspicuous, close: stem brown, somewhat lacerate scaly, leathery, sulcate, with a small thickened bulb at the base, 2–3 cm. long, 3–5 mm. in diameter; capillitium lightish yellow, hyaline, branched, threads long and slender, 4–6 μ wide, free ends rounded, occasionally septate, somewhat swollen at the joints: spores subglobose, minutely warted, some short pediceled, 3–5 μ in diameter. (Pl. 34, f. 10–12.)

COLORADO, *Bethel*, 21.

14. TYLOSTOMA FIMBRIATUM Fries, Syst. Myc. **3**: 43. 1829

Peridium subglobose, 1–1.5 cm. high, 1–1.5 cm. in diameter: outer peridium retreating, having a smooth, brownish surface to

the thin inner peridium: mouth raised, fimbriate, collar irregular, inconspicuous, close: stem white within and fibrillose stuffed, brownish and lacerate scaly outside, with a small mycelial bulb at the base, 1.5–5 cm. long, 5 mm. in diameter: capillitium light-colored, almost white, hyaline, freely septate, swollen at the joints, 4–8 μ wide: spores subglobose, dark ferruginous, verrucose, some short pediceled, 3–6 μ in diameter. (Pl. 34, f. 7–9.)

EXSICC.: Ravenel, Fungi Car. Ex. **5**: 80; Ravenel, Fungi Am. Ex. 724.

NEW YORK, *Peck;* SOUTH CAROLINA, Ravenel; NORTH CAROLINA, *Curtis, Wood;* ALABAMA, *Earle;* TEXAS, *Wright;* WYOMING, *Nelson;* NEW MEXICO, *Wright;* COLORADO, *Cockerell;* KANSAS, *Kellerman.*

15. TYLOSTOMA PUNCTATUM Peck, Bull. Torr. Club, **23**: 419. 1896

Peridium subglobose, 1–1.3 cm. high, 1–1.3 cm. in diameter: outer peridium scaly, retreating, leaving a ring around the base of the peridium: inner peridium thin, whitish, covered with irregular shallow pits: mouth raised, lacerate, irregular, rather large: collar indistinct, close: stem equal, darker than the peridium, lacerate scaly, with a small mycelial bulb, white within, hollow or stuffed, 2–3 cm. long, 3 mm. in diameter: capillitium whitish, hyaline, branched, septate, much swollen at the joints, 4–8 μ wide: spores subglobose, yellowish cinnamon-colored, minutely verrucose, some short pediceled, 3–5 μ in diameter. (Pl. 34, f. 1–3.)

KANSAS, *Bartholomew;* NEBRASKA, *Webber;* WASHINGTON, D. C., *Braendle.* Growing in sandy pasture land.

SPECIES NOT SEEN

16. TYLOSTOMA SEMISULCATUM Peck, Bull. Torr. Club, **22**: 209. 1895

"Peridium subglobose, usually a little longer than broad, 6–8 lines broad, 9 lines long, glabrous above, ferruginous-tomentose on the lower half: osteolum entire: stem equal, about 2 inches long, even and glabrous or but slightly furfuraceous on the upper part, the lower part longitudinally sulcate, whitish: spores ferruginous, globose, .00016 to .0002 in. broad: threads of the capillitium not septate.

"Sandy soil, Nevada. Collected by C. W. Irish, communicated by T. Taylor.

"This species is separated from *T. mammosum* Fr. by its peri-

dium, which is tomentose on the lower half and not depressed, and by its stem which is distinctly furrowed on the lower half."

As this species was not seen the above original description is quoted. The same is the case with the following description of *T. Wrightii*, and the species which Morgan calls "*T. Meyenianum*." It has been thought best to include these descriptions in order that our present knowledge of the group may be accessible in a single paper.

17. TYLOSTOMA WRIGHTII Berk. Grevillea, **19**: 95. 1891

"Stem 6 cm. high, 4 mm. thick, hollow, equal, ochraceous, even, glabrous; peridium spherico-depressed, 2 cm. broad, minutely umbonate, pale, ochraceous, glabrous, the wall of the umbo disappears at maturity and forms a small circular stoma; mass of spores yellowish brown; threads of capillitium hyaline, thick-walled, aseptate, equal, very long, branched, axis lunate, 5 μ in diameter: spores glabrous, globose, pale yellow brown, minutely warted, 5–6 μ in diameter.

"On the ground. Rio Grande, North * Mexico (Wright). Type in Herb. Berk.

"Distinguished from *Tulostoma Meyenianum* in the entire mouth and the hollow, even and not striated stem."

TYLOSTOMA sp. (Described by Morgan, Jour. Cin. Soc. Nat. Hist. **12**: 163. *pl. 16. f. 5*, as *T. Meyenianum* Kl., but it is clearly distinct from that species, though it might possibly be referred to *T. obesum* C. & E.)

"Peridium depressed, globose; the cortex soon receding, leaving a smooth whitish or yellowish surface to the submembranaceous inner peridium, the apex plane with a lacerate mouth: stipe long, thick, unequal, fusiform or tapering, nearly solid, sulcate: threads of the capillitium long, much thicker than the spores, branched, hyaline: spores subglobose, even, pale brown, 4.5–5.5 mic. in diameter.

"Growing in sandy soil. New Mexico, *Wright;* Colorado, *Webber.* Plant 2–4 inches in height, the peridium ¾–1 inch in diameter, the stipe about ½ of an inch in thickness at the thickest part. Specimens referred to *T. Angolense* W. & C. do not differ otherwise than in having the stipe thickest at the apex and taper-

* Probably a misprint for *New* as Wright was not known to have collected across the Rio Grande.

ing downward instead of fusiform. *T. obesum* C. & E. appears to be founded on a specimen with the short thick stipe not fully developed."

Morgan's description was made solely from Webber's Colorado specimen which was returned to Mr. Webber who is now unable to find it. The New Mexican reference is merely a quotation from Berkeley who determined Wright's original specimens under this name.

The following tabulation will give more compactly our present knowledge of the distribution of *Tylostoma* in North America:

TYLOSTOMA.	New York.	New Jersey.	Pennsylvania.	N. Carolina.	S. Carolina.	Alabama.	Florida.	Texas.	New Mexico.	Arizona.	California.	Nevada.	Colorado.	Nebraska.	Wyoming.	Michigan.	Iowa.	Wisconsin.	Ohio.	Kansas.	Indiana.	Canada.	Cuba.	Mexico.
albicans.								+																
campestre.											+		+	+										
exasperatum.																							+	
fibrillosum.																+						+		
fimbriatum.	+			+	+	+		+	+				+		+					+				
gracile.									+															
Kansense.																				+				
minutum.													+							+				
obesum.													+											
pedunculatum.	+	+	+	+			+	+	+	+			+	+		+	+	+		+	+			+
poculatum.						+							+	+										
punctatum.														+						+				
semisulcatum.												+												
subfuscum.													+											
tuberculatum.													+									+		
verrucosum.																			+					
Wrightii.									+															

II. CHLAMYDOPUS Speg. An. Mus. Nac. Buenos Aires, **6**: 189. *pl. 4. f. 2, 3.* 1899

In describing this genus Spegazzini includes two species from Argentina, *C. clavatus*, from which we cannot separate our New Mexican material, and *C. Amblaiensis* with a distinct annulus (?), and up to the present no other species of this genus have been reported. It is evident, however, from the description and figure of *Tylostoma Meyenianum* Kl.* that that species, also, belongs to the genus *Chlamydopus*. While the figure shows no trace of a volva, its tapering stem with its broad attachment to the peridium, together with its general habit would seem to indicate its relationship to

* Nov. Act. Caes. Leop. Carol. Nat. Cur. **19**: 243. *pl. 5. f. 4.* 1843.

this genus. The volva is of such a friable nature that it would be preserved with difficulty even if the stem had not been detached by the inattentive collector. Quite recently several specimens have been found at Mesilla Park, New Mexico, which belong here. In going over the material referred to *Tylostoma*, in the Ellis collection, two other specimens, from different localities in New Mexico, were found which though destitute of volva, evidently belong to the genus *Chlamydopus* though they may constitute another species. For the present they have been placed with *C. clavatus*.

1. CHLAMYDOPUS CLAVATUS Speg. *loc. cit.*

Peridium depressed globose; 1.5–2 cm. high, 2.2–3.5 cm. in diameter, smooth, leathery, lightish fawn-colored: mouth plane, lacerate, irregular: stem 8–15 cm. long, much enlarged at the top where it joins the peridium, 1.5–3 cm. in diameter at the top, 0.5–1.5 cm. at the base, sulcate, lacerate scaly, firm, solid, of the same color within and without as the peridium: volva friable, cup-like, with flaring sides, 1.5–2.5 cm. high, having remnants of earth and sand adhering to it: capillitium very abundant, interlaced, lightish yellow, hyaline, branched, sparingly septate, not swollen at the joints, the free ends usually rounded, 5–7 μ wide: spores subglobose, dark ferruginous, densely verrucose, 4–6 μ in diameter. (Pl. 35, f. 1–6.)

NEW MEXICO: Mesilla Park, *Cockerell*, Mesa, *Garcia*, Las Cruces, *Wooton*. Sandy soil under mesquite.

Aside from its technical characters this species presents a habit very unlike any species of *Tylostoma* found in this country. Its clean smoothish peridium and stem are quite in contrast with the usual condition found in the species of *Tylostoma*, where the rough outer peridium, and usually the stem also, is frequently covered with fragments of adhering soil. Also in the specimens of this genus, the capillitium threads are not as distinct as those of *Tylostoma* and have considerable white amorphous hyaline tissue intermingled with them.

III. BATTARREA Persoon,* Syn. Meth. Fung. 129. *pl. 3. f. 1–3.* 1801

It has been impossible to trace the history of *Battarrea* to its very beginning as the Acta Anglica, in which Woodward makes

* This genus was named for Antonio Battarra, an early Italian mycologist, and was first erroneously spelled *Batarrea* by Persoon. In 1804 the name was changed by Palisot de Beauvais to *Battarea*, but the correct spelling, *Battarrea*, was not adopted until 1825 by Fries.

first mention and gives the first drawing of this plant, has been inaccessible, but as early as 1785 Dickson * described *Lycoperdon phalloides*—"volvulatum stipilatum, pileo deflexo campanulato; supra pulverulento calyptrato, infra glabro libero"—which unquestionably was the original *Battarrea*. It was collected in September by D. Humphreys and T. Woodward at Norwich, Norfolk and Bungay, Suffolk, England. In 1801, Persoon established the genus, and named and figured one species, *B. phalloides*, which he describes as follows—"volulata stipitata, Pileus deflexus, campanulatus, villosus, pulueris strato obsitus, a volua calyptratus." In 1814 Liboschitz † made the next mention, when he described a plant which he named *Dendromyces Stevenii*, from the river Volga, which Fries in 1839 referred to *Battarrea*. De Toni ‡ gives eight species, and Fischer § mentions seven of these, while quite lately, in 1899, Spegazzini || described two new species from Argentina, making the number of described species ten in all.

The first *Battarrea* reported in this country was *B. phalloides* ** in 1873, said to have been collected by J. Torrey in the vicinity of San Francisco, Cal., but strangely enough, though this is the well-known European species, it has never since been found, to my knowledge, in the United States. Owing to the lack of description of the plant mentioned there is a question as to whether this plant really belongs to the species indicated. The only other species so far known in this country are *B. attenuata* from Nevada, described by Professor C. H. Peck †† in 1895, and *B. Digueti*, described in the following year by M. Patouillard ‡‡ from Lower California. Lastly some material has been sent to Professor L. M. Underwood from New Mexico and Arizona which proves to belong to two undescribed species.

A list of the hitherto known species with their localities is added:

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* Plant. Crypt. Brit. **1**: 24. 1785.
† Beschreibung eines neuendeckten Pilzes. 1814.
‡ Saccardo, Syll. Fung. **7**: 65; **9**: 270; **14**: 260.
§ Engler & Prantl, Die nat. Pflanzenfam. 1** : 344. 1900.
|| An. Mus. Nac. Buenos Aires **6**: 190, 191. 1899.
** Grevillea **2**: 35. 1873.
†† Bull. Torr. Club, **22**: 208. 1895.
‡‡ Jour. de Bot. **10**: 251. *f. 2.* 1886.

B. PHALLOIDES Pers. England, Italy, North America (?).
B. GAUDICHAUDII Mont. Peru.
B. GUICCIARDINIANA Ces. Italy.
B. TEPPERIANA Ludw. Australia.
B. STEVENII (Libosch.) Fries. Siberia.
B. DIGUETI Pat. & Har. North America.
B. ATTENUATA Peck. North America.
B. MUELLERI Kalchbr. Australia.
B. GUACHIPARUM Speg. Argentina.
B. PATAGONICA Speg. Argentina.

Synopsis of the North American Species

Stem hollow.
Plants more than 20 cm. high; volva double, the inner layers split into numerous leaves. 1. *B. laciniata.*
Plants 20 cm. high or less.
Spores minutely verrucose; volva simple. 2. *B. Griffithsii.*
Spores nearly smooth; volva triple. 3. *B. Digueti.*
Stem solid. 4. *B. attenuata.*

1. **Battarrea laciniata** Underwood, sp. nov.

Peridium 5–6 cm. in diameter, 2–3 cm. high, smooth, membranaceous, the upper portion sometimes having portions of the outer coat of the volva adhering to it: the lower portion after the spores have been shed is a yellowish-white and shows traces of where the capillitium has sprung: stem 25–35 cm. long, woody, hollow, stuffed with silky, thread-like fibers running about half way down the center of the stem, outer coat fibrous, pealing, sometimes merely lacerate, at others shaggy, slightly tapering to the base, about 2.5 cm. at the top and 1.5 cm. at the base: volva complex, composed of a thick outer coating, and an inner set of very numerous thin leaflets arranged more or less in layers about the stem: capillitium whitish, hyaline, indefinite, irregular, somewhat fascicular: cells 30–50 μ long, 5–7 μ wide, with raised annular thickenings or nearly flat spiral markings: spores subglobose, reddish-brown, 5–7 μ in diameter, almost smooth. (Pl. 36, f. 1–6.)

NEW MEXICO: Mesilla Park, *Cockerell.*

This plant resembles *B. Digueti* in some of its characters, but it is distinguishable (1) By its much larger size, (2) By its having no inner woody volva enclosing the lower portion of the stem, (3) In the much larger number of leaflets which compose the inner portion of the volva, and (4) In the different coloring and marking

of the cells. The plants vary considerally as to size and roughness of the stem.

2. **Battarrea Griffithsii** Underwood, sp. nov.

Peridium 2–3.5 cm. in diameter, 1–2 cm. high, smooth, membranaceous, lower part flat, showing the line of dehiscence distinctly: stem hollow, equal, 1–1.5 cm. in diameter, 9.5–15 cm. long, sulcate, pealing fibrillose: volva fairly well marked, composed of a few appressed fibrillose blunt squamules: capillitium 4–10 μ wide, whitish, flattened, rather amorphous, branched, and having a large number of cells mixed with it: cells darker than the capillitium, with spiral markings and annular thickenings, 6–8 μ wide, 24–85 μ long: spores subglobose, minutely verrucose, looking smooth except under very high magnification, reddish-cinnamon colored, 4–5 μ in diameter. (Pl. 37, f. 1–6.)

ARIZONA, *David Griffiths*, to whom the species is dedicated.

3. BATTARREA DIGUETI Pat. & Har. Jour. de Bot. **10**: 251. *pl. 2. f. 1–6.* 1896

Peridium depressed globose, membranaceous: stem 15–20 cm. long, 8–10 mm. wide: spores globose, ferruginous, 5–6 μ in diameter: cells 100–150 μ long, 4–7 μ wide, with darker yellow annular markings: volva of three layers, the outer one woody, simple, whitish, the inner woody and simple, and encircling the lower third part of the stem, the third layer between the outer and inner volva is composed of from 10 to 20 thin membranaceous leaflets.

LOWER CALIFORNIA, *Diguet.* In barren rocky soil.

No specimens of this species have been seen, but it has been thought best to quote the above partial translation of M. Patouillard's very full description.

4. BATTARREA ATTENUATA Peck, Bull. Torr. Club, **22**: 208. 1895

"Exoperidium unknown: endoperidium 2 in. or more in breadth, the basal part hard, thick, even and concave beneath, convex above, and somewhat coarsely reticulated by the bounding walls of broad shallow pits: stem 8 to 10 in. long, gradually attenuated toward the base, hard, almost woody, solid, rough except at the top, with rather coarse spreading or reflexed scales, brown externally, rusty brown within: spores globose, ferruginous, .0003 in. broad: threads of the capillitium destitute of spiral thickenings.

"Plant commonly growing in tufts of 3–5 individuals. Dry sandy soil. Nevada. Collected by C. W. Irish; communicated by Dr. Thomas Taylor."

The single specimen of this species known is at Albany and is inaccessible at the present time, so the above original description has been quoted verbatim.

IV. QUELETIA Fries. Öfversigt Kongl. Vetens. Akad. Förhandlingar, Stockholm, 171. *pl. 4.* 1871

This genus was established on a single species, and as yet no others are known. It is very rare, having been reported from very few localities. It was discovered by Dr. L. Quelet, at Herimncourt, France, and has since been reported from the environs of Rouen (Saint-Saens), and Pont de Sochaux, France. It has been found only once in the United States, at Trexlertown, Penn., by Mr. William Herbst, and was reported by Professsor C. H. Peck, in his 46th report of the State Botanist. He is of the opinion that this plant was introduced into this country in some way with tan bark, on which it usually grows.

1. QUELETIA MIRABILIS Fries, *loc. cit.*

Peridium globose, 2.5–3.5 cm. high, 3–4 cm. in diameter, fragile, easily separating from the stem, rupturing irregularly, of a reddish-brown color: collar irregular, of the same substance as the peridium: stem 6.5–8 cm. long, 1.5 cm. wide at the top, 2 cm. at the base, fascicular, reddish-brown, within and without, like the peridium, solid, lacerate, fibrillose, particularly at the base: capillitium very abundant and interwoven, forming with the spores a felt-like mass, reddish-brown, single threads whitish-yellow, thick-walled, hollow as shown by the truncated ends, septa rare or wanting, 5–9 μ wide, branches rather short, free ends rounded and recurved: spores subglobose, coarsely warted, 4–6 μ in diameter, some short-pediceled, inner portion breaking up and issuing from the thin-warted coating which is then hyaline and shrivelled. (Pl. 38, f. 1–5.)

PENNSYLVANIA: Trexlertown, *Herbst.* On spent tan bark. Summer, after rains, forming circles.

V. **DICTYOCEPHALOS** Underwood, gen. nov.

Plants with the irregularly rupturing peridium closely attached to the solid stem. Volva cup-like, persistent at the base of the stem. Gleba composed of a mesh-like irregular tissue, in which the capillitium threads are embedded.

1. **Dictyocephalos curvatus** Underwood, sp. nov.

Outer peridium of a thick woody texture, bearing a definite cup-like volva at the base of the stem, the upper portion being carried up on the peridium, and either falling off or remaining adherent to it: inner peridium scleroderma-like, rough, dark brown, scaly, rather flattened sideways, rupturing irregularly, 3–6 cm. high, 5–8 cm. in diameter: stem 25–40 cm. long, 3–6 cm. in diameter at the summit, 1.5–4 cm. in diameter at the base, considerably flattened, twisted, solid, dark brown within and without, sulcate, the outer surface very uneven, and peeling: the collar indistinct, formed by the lower portion of the peridium adhering to the top of the stem and becoming torn as the stem elongates: the top of the stem is rounded and projects into the peridium forming a pseudo-columella, of a yellowish-brown color, lighter than the rest of plant, marked with irregular, reticulated pits, from the sides of which the mesh-like tissue springs which forms with the spore mass the main part of the gleba: capillitium 8–10 μ wide, mostly embedded in the mesh-like tissue, bright yellow, cylindric, septate, not much swollen at the joints, branched, the free ends rounded: spores subglobose, warty, 5–7 μ in diameter. (Pl. 39, 40.)

COLORADO: Colorow, *Bethel.*

Plants with a strong odor which in the dry condition much resembles that of the dried bark of *Ulmus fulva.* The spores of these specimens first appeared to be of two kinds—darker warted, larger ones, and smaller, smooth, light colored ones—but it was soon seen that this was owing to the outer coat having been eaten off by the quantities of small insects by which these plants were infested.

These strange plants were found by Mr. E. Bethel at Colorow, Col., in the month of August, 1897. In the notes sent with these specimens to Mr. Ellis, Mr. Bethel says: "These plants are very odd-looking in their native haunts; they grow on a soft alkaline adobe soil. Some of them had lifted themselves entirely out of the ground, while others had the stalk standing in about one inch of soil. They presented a very fantastic appearance, as there was little or no other vegetation about. * * * Some of the specimens were very much bent, approximating a semicircle, others were twisted like a corkscrew, with the portions of the stalk split and bent back. I think the chief factor in lifting the plant out of the ground is this twisting and bending back of the portions of the stem during dessication."

Explanation of Plates

In most cases the drawings have been made twice natural size and reduced one half. The capillitium and spores were drawn with a camera lucida under double the magnification noted.

PLATE 31

FIG. 1. *Tylostoma pedunculatum*, nat. size.
FIG. 2. Spores and capillitium, × 170.
FIG. 3. Spores, × 310.
FIG. 4, 5. *Tylostoma albicans*, nat. size.
FIG. 6. Spores and capillitium, × 170.
FIG. 7. Spores, × 310.
FIG. 8. *Tylostoma verrucosum*, nat. size.
FIG. 9. Spores and capillitium, × 170.
FIG. 10. Spores, × 310.
FIG. 11. *Tylostoma minutum*, nat. size.
FIG. 12. Spores and capillitium, × 170.
FIG. 13. Spores, × 310.

PLATE 32

FIG. 1. *Tylostoma gracile*, nat. size.
FIG. 2. Spores and capillitium, × 170.
FIG. 3. Spores, × 310.
FIG. 4. *Tylostoma obesum*, nat. size.
FIG. 5. Spores and capillitium, × 170.
FIG. 6. Spores, × 310.
FIG. 7. *Tylostoma Kansense*, nat. size.
FIG. 8. Spores and capillitium, × 170.
FIG. 9. Spores, × 310.

PLATE 33

FIG. 1. *Tylostoma exasperatum*, nat. size.
FIG. 2. Spores and capillitium, × 170.
FIG. 3. Spores, × 310.
FIG. 4. *Tylostoma fibrillosum*, nat. size.
FIG. 5. Spores and capillitium, × 170.
FIG. 6. Spores, × 310.
FIG. 7. *Tylostoma tuberculatum*, nat. size.
FIG. 8. Spores and capillitium, × 170.
FIG. 9. Spores, × 310.
FIG. 10. *Tylostoma campestre*, nat. size.
FIG. 11. Spores and capillitium, × 170.
FIG. 12. Spores, × 310.

PLATE 34

FIG. 1. *Tylostoma punctatum*, nat. size.
FIG. 2. Spores and capillitium, × 170.
FIG. 3. Spores, × 310.
FIG. 4. *Tylostoma poculatum*, nat. size.
FIG. 5. Spores and capillitium, × 170.
FIG. 6. Spores, × 310.

FIG. 7. *Tylostoma fimbriatum*, nat. size.
FIG. 8. Spores and capillitium, × 170.
FIG. 9. Spores, × 310.
FIG. 10. *Tylostoma subfuscum*, nat. size.
FIG. 11. Spores and capillitium, × 170.
FIG. 12. Spores, × 310.

PLATE 35

FIG. 1. *Chlamydopus clavatus*, nat. size.
FIG. 2. Spores and capillitium, × 170.
FIG. 3. Spores, × 310.
FIG. 4. Single spores, × 450.
FIG. 5. Peridium showing lacerate mouth, and enlarged stem, nat. size.
FIG. 6. Section through peridium and stem.

PLATE 36

FIG. 1. *Battarrea laciniata*, ½ nat. size.
FIG. 2. Spores and capillitium, × 170.
FIG. 3. Spores, × 310.
FIG. 4. Cells, × 310.
FIG. 5. Cell after desiccation, × 310.
FIG. 6. Peridium, nat. size, showing attachment to the stem.

PLATE 37

FIG. 1. *Battarrea Griffithsii*, nat. size.
FIG. 2. Specimen showing under side of peridium, volva missing, nat. size.
FIG. 3. Peridium showing method of dehiscence, nat. size.
FIG. 4. Spores, capillitium and cells, × 170.
FIG. 5. Spores, × 310.
FIG. 6. Cells, × 310.

PLATE 38

FIG. 1. *Queletia mirabilis*, nat. size.
FIG. 2. Spores and capillitium, × 170.
FIG. 3. Spores, × 310.
FIG. 4. Spores, showing breaking up of inner substance, × 310.
FIG. 5. Section through the peridium, showing detachment of stem, nat. size.

PLATE 39

FIG. 1. *Dictyocephalos curvatus*, ½ nat. size.
FIG. 2. Lower portion of stem, and double volva, ½ nat. size.
FIG. 3. Peridium, ruptured irregularly, with remnants of mesh-like tissue, ½ nat. size.
FIG. 4. Portion of tissue with spores and capillitium embedded in it, × 170.

PLATE 40

FIG. 5. *Dictyocephalos curvatus*, ¾ nat. size.
FIG. 6. Spore, × 465.
FIG. 7. Inner portion of spore issuing from outer coat, × 465.
FIG. 8. Empty, hyaline spore coats, × 465.
FIG. 9. Smooth inner spores after issuing from outer coat, × 465.

Some Points in the Anatomy of Chrysoma pauciflosculosa*

By Francis E. Lloyd

The material upon which these notes are based was collected by the writer on Cat Island, one of the Mississippi Sound series. This region lies in the northern edge of the tropical life zone, and is characterized by the presence of a goodly number of tropical strand plants.† *Chrysoma pauciflosculosa*, may be considered as one of these, indigenous to America, with a northern range extending to South Carolina on the Atlantic Coast. Its habitat according to Chapman ‡ is "sandy banks and shores," and appears to be a halophytic plant, at least in some localities. The plant is a shrub a meter or over in height, having vertical isolateral leaves. These are rigid, with three prominent longitudinal views, and are covered with an aromatic gummy exudate.

Using the floral characters as a basis the plant has been by some authors referred to the genus *Solidago*, from which it was separated first by Nuttall, who has been followed more recently by Greene. The reasons for which this has been done are found in the habit, woody character, and inflorescence of the plant. It is our present purpose to examine more particularly some points in the anatomy of the leaf.

In shape the leaf is narrowly elliptical, tapering into a short petiole. When examined by transmitted light it appears "pellucidly punctate" an appearance which is due to the peculiar arrangement of the internal tissues and not to accumulations of a secretion in cavities, as for example, in the Hypericaceae. Further observation by reflected light shows that each of the polygonal,

* Shortly before her death Dr. Emily L. Gregory, with whom two of her students, Miss Alice M. Isaacs and Miss Marion Satterlee, worked in collaboration, examined this plant. The results of their observations were presented in a paper read before the Torrey Botanical Club on January 14, 1896. Had Dr. Gregory's death not occurred, the paper would undoubtedly have been published. The writer has very kindly been given access to these results by Miss Isaacs, whom he wishes here to thank. The present paper is largely a verification of the observations presented in 1896.

† For a fuller account of this region see Lloyd, F. E., and Tracy, S. M., The Insular Flora of Mississippi and Louisiana Bull. Torr. Club, 28: 61–101. 1901.

‡ Flora of Southern States.

pellucid areas is surrounded by a sulcus. In drying they shrink inwardly, giving rise to the term "pitted" as applied to the leaf surface, which however would better be described as a mosaic. Both sides of the leaf have the same appearance, the reason for which will be better understood by an examination of the internal structure.

The sulci just referred to are caused by the dipping down of the epidermis on both sides of the leaf to a depth equal approxi-

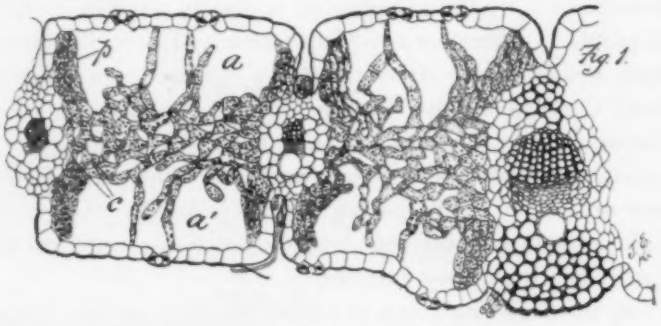

FIG. 1. Transverse section of leaf, through the midrib and two pairs of air chambers.

mately to one third of the thickness of the leaf. (Fig. 1.) The epidermal cells which line the sulcus are of gradually decreasing depth, the deeper they are placed. Between the sulci the epidermis stretches almost without support. The arrangement of the mesophyll is such that there is thus formed a disposition of

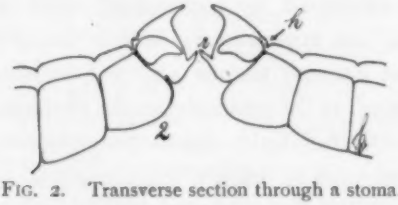

FIG. 2. Transverse section through a stoma.

tissues which suggests at once the well-known air chambers of the liverwort, *Marchantia*. In the roof of epidermal cells, which are cuticularized both within and without, are found the stomata, one of which is shown in detail in Fig. 2, in which are delineated the hinge line (*h*) and an inner guard ridge (*r*) making a sensitive and effective stoma. The effectiveness is heightened by the ac-

cessory cells lying adjacent, the presence of which in the Compositae is, so far as known, of rather rare occurrence, according to Benecke.* These cells are not, however, as well differentiated as in *Carlina* (Benecke, *l. c.*), but nevertheless serve to raise the stoma somewhat above the level of the epidermis, and, by the conformation of their walls, to aid in closing the aperture.

The stomata are to be found only in the "pellucid" areas, from the margins of which they are absent. In each area there are, on an average, about 22. They are found also upon the rounded edges of the leaf. The average size of the areas is 0.19 sq. mm. The stomata are therefore relatively numerous in the areas in which they occur.

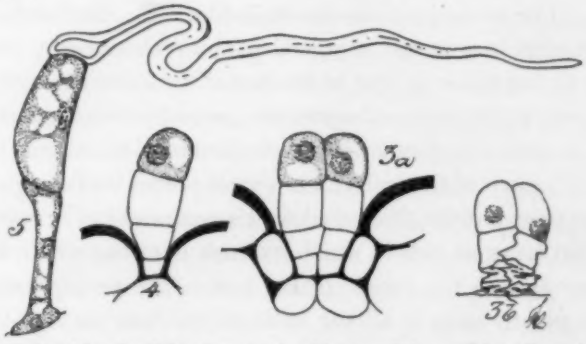

FIG. 3*a*, Double glandular hair; 3*b*, older condition, with collapsed cells; 4, single glandular hair; 5, whip hair.

The exposed surface of the leaf is entirely smooth and free from organs such as hairs. The cuticle is sculptured into irregular ridges, chiefly over the veins, and inconstantly over the rest of the surface. Two kinds of hairs grow in abundance at the bottoms of the sulci. Of these, one sort is glandular, the other, the so-called whip cells.†

The former are composed of two series of four cells each, the basal cells being the smallest (Fig. 3*a*). Their walls are thin and have a delicate cuticularized external layer. In the terminal cell one always finds a rounded mass of calcium oxalate crystals. In the mature leaf the three lower cells appear empty and are collapsed

* Bot. Zeit. 1892.

† Vesque, J., Caractères des * * * gamopetales * * * . Ann. Sci. Nat. Bot. VII., 1: 183. 1885.

while the terminal cell maintains its shape and contents. (Fig. 3*b*.) In type this form of hair agrees with that described by Vesque (*l. c.*) which he found at the base of the heads of *Chrysanthemum coronarium*. The contour differs however. Occasionally one finds such a hair composed of but one row of cells (Fig. 4). In all cases so far observed the two series of cells, when two are present, arise from two neighboring cells of the leaf, a fact which leads to the view that we have before us a case of concrescence. This must however be verified by a study of their development.

The whip hairs (Fig. 5), on the other hand, are quite different in form and function. They are composed of one series of four cells. The basal cell is lenticular, with or without a projecting portion. The second is a slender stalk-like cell; the third a thicker and somewhat longer cell, supporting at its outer end a long lash cell, four to five times as long as the rest of the hair. At the base of the lash cell is a bulbous enlargement upon which the lash is set obliquely, as occurs in similar hairs in *Carduus lanceolatus* (Vesque, *l. c.*). The lumen of the lash cell is almost obliterated except toward and at the base, and the thickened wall is composed of cellulose, with a very thin layer of cuticle which extends over the whole hair and is continuous with the cuticle of the leaf. The protoplasmic contents are plainly seen in all the cells of the hair except the lash cell, from which they appear to be absent in maturity. The whip cells, the lash of which is somewhat curled, usually protrude out of the sulcus and their slender ends lie upon the exposed leaf surface. They occur in greatest numbers at the juncture of the sulci.

When one asks concerning the function of these hairs the answer is more difficult for the whip cells than for the gland cells. From the latter is exuded the gummy secretion which renders the leaf more effectually protected against the loss of moisture. The activity of secretion is resident chiefly, or probably entirely, in the terminal cell, as is indicated by the accumulation of calcium oxalate. The whip cells occur, in cases so far as known, only as part of a tomentose or arachnoid covering (Vesque, *l. c.*). We may regard them here as useless morphological members, or we may ascribe to them some function, such as leading by capillarity the gummy secretion out upon the leaf surface exposed to the air. That this takes place there is no doubt, though that this is more than an incidental phenomenon may be doubted.

The mesophyll offers some points of very great interest. No palisade tissue may be said to exist in the ordinary acceptance of the term. Dorsiventral differentiation is quite absent. We do find, however, a distinct division into two forms of chlorenchyma. Speaking with reference to a single chamber we may describe these two forms as follows. (1) There is a tightly packed mass of cylindrical cells with their longitudinal axes approximately perpendicular to the leaf surface, and with small intercellular spaces. (*p*, Fig. 1.) This mass lies against the side walls of the chamber, and abuts upon the margin of the roof; here, in the roof, are no stomata. Deep in the leaf, near the middle, the form of the cells changes to that of irregular "collecting" cells (*c*, Fig. 1) which lie against each other, and large parenchymatous elements which receive the products of photosynthesis. (2) A very loose spongy chlorenchyma with large intercellular spaces extends across the floor of the chamber, and separates the two air spaces (*a*, *a'*, Fig. 1) on opposite sides of the leaf. From this loose chlorenchyma extending to either face of the leaf are columns composed of a single series of cells—filaments in effect—which abut upon the epidermal cells and are attached to them. Altogether the chlorenchyma presents a most curious and unique arrangement, in which the palisade may be regarded as really present but, for some secondary reason pushed, so to speak, to the sides of the air chambers. What ecological explanation may be offered? We would suggest that we are dealing here with a very delicate mechanism for controlling the loss of water. It has been remarked that the epidermis is cuticularized on both sides, while the chlorenchyma is free from cuticle. On the assumption that a reduction in turgidity would affect first the chlorenchyma, the rigidity of the columns would thereby be lessened and the epidermal roof would sink in. Such a movement would effect the simultaneous closure of the outer entrances of all the stomata without causing any change in the relative position of the inner guard ridge, within which, the stomata being lifted up somewhat would be the center of oscillation of the guard cells. A very slight movement would suffice for a relatively great change in the total cross section of the outer entrances of the stomata. The writer has sought to determine if a sinking in of the roof actually occurs.

By applying glycerine to thick sections of alcoholic material he has in the majority of cases been able to produce the movement. The results, however, are not convincing, and more exact studies should be carried out upon living material. If this explanation holds good, the position of the palisade cells may be accounted for as contributive to the formation of the diaphragm.

An alternative explanation may be found in the light relations. Vertically placed leaves or their physiological equivalents are commonly supplied with palisade tissue on both faces (isolateral), but hitherto no such peculiar grouping of the chlorenchyma in an isolateral leaf has come to light. Such grouping therefore appears to be secondary and to be accounted for in some other way. The best we can do, therefore, is to admit our ignorance and await experimental evidence.

No further matters in the anatomy of this plant need receive mention at this time beyond the remark that the shrubby character of the plant and its peculiar leaf anatomy clearly separate it from the genus *Solidago*, in which, so far as at present known, no approach to our plant in either regard is to be found, even in halophytic species.

In summarizing we point out the following matters of general interest:

1. The leaf of *Chrysoma pauciflosculosa* is bifacial, isolateral, and of unique structure.

2. Two kinds of hairs are present, which agree with the morphological types found in the Compositae, as defined by Vesque.

3. The stomata correspond closely in structure to those of the majority of halophytes, as described by Warming in his Halofyt Studier, but possess a more specialized inner entrance. They are provided with accessory cells (Nebenzellen), which are not, however, very regularly placed.

4. The arrangement of the mesophyll possibly stands in mechanical relation with the stomata.

5. The perennial shrubby character of the plant and its peculiar leaf anatomy separate it definitely from the genus *Solidago*.

I have to thank Mr. J. E. Kirkwood for the sketch forming Fig. 1.

BONN, March, 1901.

Dasystoma flava and some related Species

By John K. Small

Specimens of *Dasystoma* that have recently accumulated in the herbaria at the New York Botanical Garden indicate a segregation of species in the *Dasystoma flava* group as follows: *

Key to the Species

Upper leaves and bracts with pinnatifid blades. 1. *D. grandiflora.*
Upper leaves and bracts with entire or merely toothed blades.
Pedicel shorter than the calyx.
Upper leaves and bracts with toothed blades. 2. *D. serrata.*
Upper leaves and bracts with entire blades.
Racemes continuous: flowers approximate: calyx densely pubescent.
Capsules about 1 cm. long, scarcely beaked. 3. *D. brachycarpa.*
Capsules about 1.5 cm. long, long-beaked. 4. *D. flava.*
Racemes much interrupted: flowers remote: calyx glabrate or merely puberulent. 5. *D. dispersa.*
Pedicel longer than the calyx. 6. *D. patula.*

1. Dasystoma grandiflora (Benth.) Wood

Gerardia grandiflora Benth. Comp. Bot. Mag. 1: 206. 1835.
Dasystoma grandiflora Wood. Bot. & Flor. 231. 1873.

In open woods, Wisconsin and Minnesota to Tennessee and Texas.

2. **Dasystoma serrata** (Torr.)

Gerardia serrata Torr.; Benth. in DC. Prodr. 10: 521. 1846.

Perennial, grayish puberulent or finely pubescent. Stems 4–12 dm. tall, often widely branched: leaf-blades pinnatifid on the lower part of the stem and their segments entire, merely serrate and much smaller above: calyx-tube 5–6 mm. broad during anthesis; lobes linear-lanceolate to lanceolate, entire: corollas 2.5–4 cm. long: capsules ovoid or globose-ovoid, 1–1.5 cm. long, short-beaked.

In dry soil, Missouri to Louisiana and Texas.

Louisiana: *Hale*, no. 249.

Missouri: McDonald County, *Bush*, no. 272; Swan, *Bush*, no. 677.

* Species hitherto undescribed and newly combined binomials are indicated by heavy face type.

3. **Dasystoma brachycarpa**

Perennial, puberulent or finely pubescent. Stems 6–15 dm. tall, usually simple below the inflorescence: leaf-blades leathery, oblong-ovate, oblong-lanceolate or lanceolate, 5–12 cm. long, incised or repand on the lower part of the stem, entire or merely undulate and shorter above: racemes continuous: flowers very short pedicelled: calyx-tube campanulate at maturity; lobes as long as the tube or longer: corollas 2.5–3 cm. long, with widely dilated tubes: capsules globose-ovoid, about 1 cm. long, scarcely beaked.

In dry sandy soil, Stone Mountain, Georgia.

The specimens on which this species are based were collected by the writer on the slopes of Stone Mountain, Georgia, September 6–12, 1894, and are in the herbaria both of Columbia University and the New York Botanical Garden.

4. DASYSTOMA FLAVA (L.) Wood

Perennial, grayish pubescent or sometimes merely puberulent. Stems 3–12 dm. tall, simple, or branched above: leaf-blades lanceolate to oblong, 4–14 cm. long, repand, coarsely toothed or rarely pinnatifid on the lower part of the stem, entire or merely undulate above: racemes continuous, at least during anthesis: calyx-tube turbinate at maturity; lobes as long as the tube or much longer: corollas 3–4 cm. long: capsules ovoid-conic, about 1.5 cm. long, long-beaked.

In open woods and thickets, Ontario and Wisconsin to Massachusetts, Florida and Mississippi.

5. **Dasystoma dispersa**

Perennial, inconspicuously puberulent, blackish in drying. Stems 4–10 dm. tall, simple, or widely but rather sparingly branched: leaf-blades spatulate, oblong, elliptic or oblong-oblanceolate, entire, 2–6 cm. long, or longer and repand near the base of the stem, slender-petioled: racemes conspicuously interrupted, the pairs of flowers quite regularly separated by internodes 2–4 cm. long: calyx-tube 7–8 mm. broad during anthesis, glabrate or merely puberulent; lobes about as long as the tube or usually shorter: corollas 3–3.5 cm.

In pine woods and on hillsides, Alabama, Mississippi and Louisiana.

ALABAMA: no locality, *Gates*.

MISSISSIPPI: Biloxi, *Tracy*, no. 5108.

LOUISIANA: Feliciana, *Carpenter;* type in the herbarium of Columbia University.

6. DASYSTOMA PATULA Chapm.

Dasystoma patula Chapm. Bot. Gaz. **3**: 10. 1878.

On river banks, Tennessee and Georgia.

A local, and very characteristic species thus far found only in the two states cited above.

On a Collection of Plants made in Georgia in the Summer of 1900

By Roland M. Harper

(With Plate 29)

Having made plans to spend the past summer in studying the flora of Georgia, I left New York on the 14th of June, 1900, and arriving in Georgia the next day. While passing through North Carolina on the morning of the 15th, I noted an extension of range of an introduced plant, which might be mentioned here. At Aberdeen, Moore county, I found *Acanthospermum australe* (L.) Kuntze growing beside the track. This station is considerably farther north than the one mentioned in a previous paper,* and is probably the northernmost yet reported. In the same county, among other things of interest, I saw *Sarracenia flava* L. for the first time. It was quite abundant in moist pine-barrens from Lemon Springs to Aberdeen, a distance of about 22 miles.

My first stop in Georgia was at Athens, where I had collected many interesting plants in previous years. Here I spent about three weeks, collecting plants numbered 1 to 161, all in Clarke county. During June my operations were considerably interfered with by unusually frequent rains, and on this account I did not have a chance to visit some of my favorite localities in adjacent counties.

On July 8th I went to Atlanta, where I was joined by Mr. Percy Wilson, of the New York Botanical Garden, who accompanied me during the next four weeks.

During a week spent in Atlanta we made trips to several points of botanical interest in the vicinity. On the afternoon of the 9th we collected along the bank of the Chattahoochee River in Cobb county, and on 10th we spent the day at Stone Mountain, in DeKalb county, which has been made famous by the researches of Porter, Ravenel, Canby, Gray, Small and several other botanists. Fig. 1 is a view of the mountain from the northeast, about a mile distant, showing the precipitous north side.

* Bull. Torr. Club, 27: 341. 1900.

On the 12th we went to Kennesaw Mountain, in Cobb county, 20 miles northwest of Atlanta, whose summit is the highest point in Georgia south of the 34th parallel (1809 feet). This mountain is well known historically, having been the scene of an important battle on June 27, 1864, but has apparently never been mentioned in botanical literature. Kennesaw is mostly covered with woods, and its flora seems to be richer in species than that of Stone Mountain, which is mostly bare rock. Many species are common to the two mountains, but those on Kennesaw are in general plants of less restricted range.

On the afternoon of the 14th Mr. Wilson made a short trip to De Kalb county, while I went to the northern part of Clayton county, about 10 miles southwest of Atlanta, where I discovered new stations for two or three rare species. While in the vicinity of Atlanta Mr. Wilson collected plants numbered 1 to 61, and I increased my numbers to 241.

We left Atlanta on the morning of July 17th, and went *via* the Southern Railway to Dalton, the county seat of Whitfield county, about 100 miles to the northward. Up to this time we had been collecting in the Archaean or granite region, but on the way to Dalton we passed into the newer terrane of the Palaeozoic.

Between Atlanta and Dalton I made notes on several interesting plants seen from the train, the most important of them being *Pinus palustris*, which has long been known to reach its inland limit in this region, though I know of no botanist who had visited this portion of its range before; and I selected the longer route to Dalton because I knew it would give us an opportunity to observe this species. It was first seen by us in the western part of Paulding county, in the Archaean region, at an altitude of about 1100 feet, and for the next 15 miles along the railroad, in Polk and Floyd counties, some specimens of this pine were nearly always in sight. In Polk county we crossed the boundary of the Palaeozoic region and began to descend rapidly, and in Floyd county, where we left *Pinus palustris* behind, our altitude was only about 600 feet.

We made Dalton our headquarters during a few weeks' exploration of Whitfield and Walker counties, which lie along the northern boundary of the state, adjacent to Tennessee, and are

both wholly in the Palaeozoic region. The principal points of interest visited during the remainder of July were the Chattoogata Mountains, a few miles west of Dalton, and Gordon Springs, in the extreme western part of Whitfield county, at the base of Taylor's Ridge. At this delightful rural retreat we spent three days, from the 25th to the 28th, crossing the ridge into Walker county, two or three times. The summits of these higher ridges in Whitfield county, are composed of sandstone rocks, of the Red Mountain (or Rockwood) formation, which represents the upper portion of the Silurian in Georgia. The lower ridges are mostly of the Knox Dolomite and Chickamauga formations (Lower Silurian).

During these trips in the latter part of July I collected my numbers 242–324, and Mr. Wilson his numbers 62–160.

Having decided to explore the still higher mountains of the Lookout plateau to the west of us, we set out on July 31 and walked across Chattoogata, Taylor's, and several smaller ridges, to Lafayette, the county seat of Walker county, about 25 miles west of Dalton. With Lafayette as a base, on the first three days of August we made trips to different portions of Pigeon Mountain, a few miles to the westward, and also collected several plants in the immediate vicinity of Lafayette, which is in a valley of Oostanaula (or Connasauga) shale, a part of the Cambrian formation.

Pigeon Mountain is a spur of Lookout Mountain, and, like Lookout, is a synclinal plateau, capped by coal measures (Carboniferous). The rock of the coal measures here is a sandstone, scarcely distinguishable from the Red Mountain sandstone. Below the coal measures the Mountain (or Bangor) Limestone is exposed over a large area on the lower slopes of the mountain. This is a compact bluish limestone, and many interesting plants are found on it. Below the carboniferous rocks is a stratum of Devonian rocks about 25 feet thick, known as the Chattanooga Black Shale. This outcrops all along the base of the mountain, but is rarely visible, on account of the ease with which it disintegrates where exposed.

The highest point of Pigeon Mountain is 2329 feet above sea level, and about 1400 feet above the adjacent valleys. On the first of August we ascended to this high point, and made the acquaintance of some of the rare plants of this mountain region.

On the following morning we collected in and near Lafayette, and in the afternoon went to the railroad tunnel at the north end of Pigeon Mountain and found a number of interesting plants on the Chattanooga Black Shale and Mountain Limestone in that vicinity.

On the morning of the third we visited Bluebird Gap, on the mountain, about midway between the points visited on the two preceding days. The same afternoon we returned to Dalton by rail, by way of Chattanooga, Tenn.

We would gladly have remained longer in this interesting region, but as we could not bring our driers over the mountains with us, our stay was limited. During our Lafayette trip Mr. Wilson collected numbers 161–210, and I numbers 324–365.

On August 5 Mr. Wilson left me, to return to New York, while I remained in Dalton ten days longer, collecting plants numbered 366 to 401 in the vicinity.

From Dalton I journeyed about 250 miles southward, and the afternoon of the 16th found me at Leslie, a small town of about 200 inhabitants, in the pine barrens of Sumter county, where I spent five weeks at the home of the mayor, an old friend of mine. From Leslie I made three trips to Americus, 12 miles northwest, on August 20, 27–29, and September 15, and two to the Flint River, 9 miles east, on September 3 and 10. The rest of the time I collected within two or three miles of Leslie. Fig. 2 is a typical scene in the pine barrens near Leslie, in which I did most of my collecting in that region.

The geological formations in Sumter county are Lower and Middle Eocene (Tertiary), with several subdivisions, overlaid by two recent formations, the Lafayette and the Columbia. The Lafayette (named for its type-locality, Lafayette county, Mississippi), which is a mixture of sand and clay in varying proportions, averaging many feet in thickness, covers nearly the whole county. In the vicinity of the Flint River this has been removed by erosion and replaced by the Columbia (named for the District of Columbia), a newer and much thinner deposit of almost pure sand. In the southeastern part of the county the Columbia formation extends back from the river about three miles, and seems to overlap the Lafayette slightly, as I have been led to infer from the character

of the existing vegetation there. The very important relations between these two superficial formations and the present flora seem to have been almost entirely overlooked by botanists. The Lafayette is briefly mentioned by Dr. Mohr in his "Timber Pines of the Southern States," and by Dr. Gattinger in his "Tennessee Flora" (in the latter under its former name of Orange Sand), but I find no mention of the Columbia in any botanical work published previous to my trip.

While in Sumter county (together with a trip to Dooly county on September 3, when I crossed the Flint River), I collected plants numbered 402 to 657.

A friend in Douglas, the county seat of Coffee county, having invited me to spend a few days with him, I now availed myself of an opportunity to visit a part of the State botanically and geologically unexplored, and on September 19th left Leslie and started for Douglas, by way of Cordele, Tifton and Waycross.

Between Cordele and Tifton a change in the topography and flora of the country I was passing through became apparent. I passed from a comparatively level region, with the water mostly in ponds and swamps occupying shallow basin-like depressions, to a slightly rolling region, with valleys occupied by sluggish streams. Here I saw *Sarracenia flava* in Georgia for the first time, and in considerable abundance. *Pinus heterophylla* began to appear, replacing *P. palustris*, and *Taxodium distichum imbricarium* became common in all the little valleys, instead of only occupying isolated depressions, as in Sumter county. I also saw many plants new to me, which the rapid motion of the train would not permit me to identify.

This change in the topography and flora is probably caused by a double change in the geological formations. Between Cordele and Tifton the Middle Eocene strata are replaced by Upper Eocene, and somewhere near the same place the overlying Lafayette becomes in turn overlaid by the Columbia. The Lafayette is covered in this way throughout most of southeast Georgia. The underlying formations no doubt influence the topography, and thereby indirectly the flora, while the superficial formations have a direct influence on the character of the flora.

At Tifton, which is in the northwestern corner of Berrien county

I had to wait from 3:30 to 5:15 p. m. for another train, and during the short time at my disposal I went out into the pine-barrens to examine the flora, which I found quite different from any to which I had been accustomed. Here I collected twelve species, numbered 658 to 669, two of which are described below as new.

It became dark soon after I left Tifton, so that I did not have much further opportunity to observe the flora that day. I noticed however that *Serenoa serrulata* began to appear a few miles east of Tifton, and the pines seemed to be all *P. heterophylla*. I am not sure that I saw *P. palustris* any more during the remainder of my trip.

In Waycross the next morning I took a short walk into the outskirts of the city before boarding the train for Douglas, and found myself in an almost perfectly level region, in which the underlying formation is probably Miocene. What I saw of the flora there did not differ much from that at Tifton, the superficial formations being no doubt the same. I collected only one species in Waycross, no. 670.

From Waycross to Douglas, a distance of 42 miles, the country is very sparsely settled, and the pine forests are almost unbroken. To my surprise I noticed that nearly every tree bears the marks of the turpentine industry, but otherwise the country is practically in a state of nature. For a distance of 35 miles out from Waycross the topography continues level, and then changes rather abruptly to a rolling country similar to that around Tifton.

This part of Georgia is a most excellent region for studying the distribution of plants, for the destructive influences of civilization have scarcely begun to make themselves felt here, and most of the species are fairly common throughout their respective areas, so that their ranges can be determined with some degree of accuracy. In the case of the more conspicuous plants one can observe many of them to good advantage while traveling by rail, as I found from experience.

Coffee county seems never to have been visited by a botanist before, and I made some interesting discoveries during my short stay there. The topography and flora around Douglas are so similar to those in the vicinity of Tifton that the geological formations are probably very nearly the same, namely, Upper Eo-

cene, overlaid by Lafayette and Columbia. My numbers 671–724 were collected in Coffee county, between September 21 and 26.

On the morning of the 28th I went from Douglas to Savannah. The afternoon of the same day I made a trip to Thunderbolt, a few miles south of Savannah, and collected nos. 725–731 in the salt marshes there; and on the 29th I spent most of the day on Tybee Island, in the same county (Chatham), at the mouth of the Savannah River. This is the easternmost point of Georgia.

Although Tybee is a famous summer resort, and the only island on the Georgia coast reached by railroad, it seems to have been almost entirely overlooked by botanists. The flora of Tybee is such as might be expected anywhere along the Georgia or Carolina coast, and although most of the plants I collected there were new to me, few are of especial interest. The surface of the whole island is covered with the sands of the Columbia formation, and the most conspicuous geological feature is the line of sand dunes along the shore, the largest ones being about twenty feet in height. On these I did most of my collecting, and also photographed a number of characteristic plants which I did not collect, such as *Sabal Palmetto*, *Uniola paniculata*, *Yucca gloriosa*, etc. One Tybee Island I collected plants numbered 732 to 754, and this ended my collecting for the summer.

During 106 days spent in Georgia I collected plants in twelve counties, and made notes on the flora of fifteen others which I passed through. Besides my regular collection of spermatophytes and pteridophytes I collected a few sets of bryophytes and thallophytes, amounting to 86 numbers, which were numbered separately from the rest. I crossed every geological formation recognized in the state (about twenty-five in number), though I did not collect plants on all of them. The observations I made on the relations between geological formations and existing flora promise to yield some interesting results when properly correlated.

The figures on Plate 29 are from photographs made with a hand camera of 4-inch focus, and are reproduced nearly natural size.

It would be impracticable to give here a complete enumeration of the plants collected by Mr. Wilson and myself in Georgia last summer, but in the following notes I will mention some of the new

or noteworthy ones. For the sake of brevity I omit the bibliographical citations of most of the species. Descriptions of those whose places of publication are not cited may be found in Chapman's Flora, third edition, or in Britton and Brown's Illustrated Flora.

ASPLENIUM ANGUSTIFOLIUM Mx.

Collected by Mr. Wilson on moist shaded cliffs of Chattanooga Black Shale near the north end of Pigeon Mountain, at an altitude of 1000 ft., August 3 (no. 210). We did not find this fern on any other formation. This station is near its southern limit.

ASPLENIUM BRADLEYI D. C. Eaton

Collected by Mr. Wilson near the summit of Stone Mountain, at 1650 ft. altitude, July 10 (no. 17), and by myself on sandstone cliffs on the east slope of Rocky Face Mountain (a part of the Chattoogata range), in Whitfield county, at 1400 ft., July 21 (no. 279).

CAMPTOSORUS RHIZOPHYLLUS (L.) Link

On August 2 I found this fern for the first time, growing on the upper portions of the Chattanooga Black Shale near Pigeon Mountain Tunnel, at 1000 ft. (no. 358).

EQUISETUM HIEMALE L.

What appears to be this species was collected by Mr. Wilson in wet clay soil just north of Lafayette, Walker county, at an altitude of 925 ft., on August 2 (nos. 192, 195). I find no record of its having been collected in the Southern States east of the Mississippi before.

LYCOPODIUM PINNATUM (Chapm.) Lloyd & Underw. Bull. Torr. Club, **27**: 155. *pl. 3, 4.* 1900

I collected this species in moist pine barrens in Sumter county on September 8 (no. 613), and in a similar locality in Coffee county on the 25 (no. 705). At the former station it was accompanied by *L. alopecuroides.*

SELAGINELLA RUPESTRIS (L.) Spring

Found in abundance on exposed granite rocks on the southwest slope of Kennesaw Mountain, at an altitude of 1220 ft. (no.

215). This is probably the southernmost known station for this species east of the Mississippi, the Florida plants being now referred to another species.

ISOETES ENGELMANNI GEORGIANA Engelm. Trans. St. Louis Acad. Sci. **4**: 384. 1882

On July 26th I discovered a second station for this little-known plant, in cool wet woods at the eastern base of Taylor's Ridge, Whitfield county, at 1100 ft. altitude (no. 310). It grew in wet clayey soil, which is probably never inundated, and was accompanied by *Panicum barbulatum*, *Isnardia palustris*, *Lycopus* sp., *Gratiola Virginiana* (no. 311), and a few other plants. Only about 25 specimens were observed, but more could probably have been found by a longer search. This station is about 36 miles north of the original one and 500 ft. higher. I am indebted to Professor Underwood for the determination of this plant.

PINUS PUNGENS Mx. f.

This tree is quite common on the Chattoogata Mountains, Taylor's Ridge, and other outcrops of Red Mountain strata, descending to about 1000 ft. Collected on the Chattoogata Mountains, July 19th (no. 263).

PINUS GLABRA Walt.

I made the acquaintance of this little-known pine on September 3d, while collecting along the Flint River (no. 560). It grows along both banks of the river, in Sumter and Dooly counties, at an altitude of about 200 ft. On the 20th of the same month I saw a few specimens in Coffee county, near Seventeen Mile Creek. It is called "white pine" by some of the natives in that vicinity, who probably consider it identical with *P. Strobus* of the north.

SAGITTARIA MOHRII J. G. Smith; Mohr, Bull. Torr. Club, **24**: 19. *pl. 290.* 1897

Collected in a very wet, slightly sloping bog among the pine barrens of Coffee county, September 25 (no. 718). Previously reported only from the original station, Mobile, Ala., which is 300 miles away.

CHRYSOPOGON SECUNDUS (Ell.) Benth.

Andropogon secundus Ell. Bot. S. C. & Ga. **1**: 580. 1818.
Sorghum secundum Chapm. Fl. S. States, 583. 1860.

Collected in dry pine barrens west of Douglas in Coffee county, Sept. 25 (no. 719). Also seen three days later in Appling, Ware, Pierce, Wayne, Liberty and Chatham counties. This species has not been reported from southeast Georgia before.

Dried specimens give little idea of the elegant appearance of this grass. The stems grow several in a tuft, and are not erect as usually described, but ascending, and slightly curved at the summit; and the graceful one-sided panicles are very handsome with their yellow anthers and long purple awns. It is known as "wild oats" by the natives of southeast Georgia. This species is not mentioned by Scribner and Merrill in their recent paper on Elliott's grasses (Circ. U. S. Dept. Agric., Div. Agrost. 29: F. 1901).

I have just found a good colored figure of it, showing the panicle and upper part of the stem, in Georgia Insects* (*pl. 13*), where it is called *Andropogon nutans*. Mr. Abbot's figure, which is over 20 years older than Elliott's description, is probably the only one ever published of this species, and it illustrates very well some of the characters I have just mentioned.

PANICUM PUBIFOLIUM Nash, Bull. Torr. Club, **26**: 577. 1899

Collected by myself in dry rocky woods in Athens, June 20 and 25 (nos. 15, 40), and by Mr. Wilson in Cobb county, July 12 (no. 27). My specimens were determined by Mr. Nash. This species seems quite distinct from any other *Panicum* I have seen in middle Georgia.

PANICUM GYMNOCARPON Ell.

Grows in considerable abundance on the muddy banks of Muckalee Creek in Americus, where I collected it on August 28 (no. 522). Although the type-locality of this species is in Georgia,

* The Natural History of the rarer Lepidopterous Insects of Georgia. Including * * * the Plants on which they feed. Collected from the observations of Mr. John Abbot, * * * by James Edward Smith, M.D., F.R.S. London, 1797. Folio. 104 plates.

I have seen no other specimens from the state besides my own, the others all being from farther west. It does not seem to be generally known that the stems of this species are often, if not usually, decumbent at the base and root from the lower nodes.

CENCHRUS MACROCEPHALUS (Doell) Scribn. Bull. U. S. Dept. Agric., Div. Agrost. 17: 110. *f. 406.* 1899

I found this species very abundant on the summits of the drifting sand dunes of Tybee Island (no. 744).

CENCHRUS INCERTUS M. A. Curtis

Collected in dry sandy soil on the banks of Gum Creek (near the Flint River) in Dooly county, September 3 (no. 570). All the specimens of this species which I have seen seem to be from the Columbia formation.

ARISTIDA SPICIFORMIS Ell.

Collected in flat pine barrens near Douglas in Coffee county, September 22 (no 686), where it was accompanied by *Polygala nana*, *Kalmia hirsuta* (no. 687), *Afzelia cassioides* (no. 688), and *Gratiola hispida* (no. 689). Also seen in Ware county, September 28. In the living state this grass bears a striking resemblance to *Hordeum jubatum*, on account of its long straight crowded awns.

ARISTIDA PALUSTRIS (Chapm.) Vasey, Contr. U. S. Nat. Herb. **3**: 45. 1892

Collected in a pine-barren pond in Sumter county, September 12 (no. 644), and in wet pine barrens near Douglas, September 22 (no. 690). Previously known only from Florida and near the Gulf coast.

SPOROBOLUS FLORIDANUS Chapm.

Collected in moist pine barrens, Sumter county, August 31 (no. 547) and September 8 (no. 611). Not definitely known outside of Florida before. The leaves of this species are unusually stiff and strong, being of about the same texture as those of *Sabal glabra* or *Serenoa serrulata*. When putting the plants into press I noticed that the leaves did not break like those of other grasses when doubled, and after my return I made some tests of their strength.

A leaf from the first collection (no. 547), 5.5 mm. wide, not twisted, and perfectly dry, sustained a weight of 27 pounds without breaking.

SPOROBOLUS COMPRESSUS (Torr.) Kunth.

Collected in moist pine barrens, Sumter county, with *S. Floridanus*, August 31 (no. 549). Previously reported only from Long Island and New Jersey, so that my discovery extends the known range of this species southwestward about 700 miles. Identified by Prof. Scribner, of the U. S. Dept. of Agriculture. *Rhexia aristosa*, another New Jersey plant, was found a short distance away a few days earlier (see below).

EUSTACHYS FLORIDANA Chapm.

In dry sand near Gum Creek, Dooly county, September 3 (no. 571), with *Cenchrus incertus* and *Paronychia riparia*. The northernmost station previously reported for this species is Bainbridge, which is about 100 miles farther down the Flint River. Like *Cenchrus incertus*, it seems to be confined to the Columbia formation.

CYPERUS SQUARROSUS L.

Abundant in sandy soil along the streets and railroad in Douglas. Collected September 22 (no. 674). This I believe is the first time it has been reported in this country north of Florida.

CYPERUS REFRACTUS Engelm.

Grows in dry rocky woods in Athens, with *C. retrofractus*, which it much resembles. Collected June 20 (no. 17). Not previously reported from Georgia.

KYLLINGA BREVIFOLIA Rottb.

K. monocephala Torr.

Collected in most soil on Tybee Island, September 29 (no. 753). I find no record of any station farther north than this.

KYLLINGA ODORATA Vahl

In muddy places in the northern part of Americus, August 27 (no. 503). Altitude about 350 ft. Not previously reported north of Florida.

Fuirena breviseta Coville

F. squarrosa var. *breviseta* Coville, Bull. Torr. Club, **17**: 6. *pl. 98. f. 6.* 1890

Collected in moist sandy soil, Leslie, August 17 (no. 403). Mr. Coville, who determined my specimens, now regards this without hesitation as a distinct species, and asks me to so publish it for him. In most of my specimens the upper leaves are deflexed, and this seems to be due to the turgidity of a portion of the base of the blade. This turgid portion is rather conspicuous on account of its whitish color.

SCIRPUS ATROVIRENS Muhl.

Collected in a marshy place south of Kennesaw Mountain in Cobb county, at an altitude of 995 ft., July 12 (no. 207). (Not previously known from middle Georgia.) Also in a wet meadow just west of Taylor's Ridge in Walker county, at 950 ft., July 31 (no. 325). The latter station is on the Chickamauga formation.

SCIRPUS POLYPHYLLUS Vahl

Found with *S. atrovirens* in both the above-mentioned localities (nos. 209, 326), also in wet woods, DeKalb county, at 950 ft. altitude, July 10 (no. 196). The station last mentioned seems to be the southernmost known for this species. It was also observed at two or three points in Whitfield county, mostly on Chickamauga strata.

SCIRPUS GEORGIANUS Harper, Bull. Torr. Club, **27**: 331. *pl. 22.* 1900

On June 18th I revisited the type-locality of this species, in Clarke county, and after some search succeeded in finding a good specimen (no. 6). On July 4th I found it in some abundance about three miles farther down the Middle Oconee River (no. 156), and on the 12th I was agreeably surprised by discovering another station for it, 62 miles west of the original, in Cobb county at 995 ft. altitude (no. 212). The specimens from this locality are in every way similar to those from the type-locality. At the Cobb county station both *S. atrovirens* and *S. polyphyllus* were collected also within a few yards, thus affording an exceptional opportunity for

comparing the three species. With the better material of *S. Georgianus* now at hand I can add somewhat to the original description. The stem is usually a meter tall, and bears as many as eight or ten leaves. The character of the sheaths of the leaves seems to be variable and of little value. Its affinities seem to be rather more with *S. atrovirens* than with *S. polyphyllus*.

SCIRPUS SYLVATICUS L.

A few large specimens of this species were collected in a small brook at the northern base of Stone Mountain, at about 950 ft. altitude, July 10 (no. 205), accompanied by *Polygonum setaceum* Baldw. (no. 206). This is its southern limit, as far as known. The locality is so near the perpendicular face of the mountain that it is probably shaded most of the time, and its temperature must be considerably lower than the average of the surrounding country. (See Fig. 1.)

ELEOCHARIS BALDWINII (Torr.) Chapm.

This rare species was collected in flat pine barrens in Waycross, at an altitude of 140 ft., September 20th (no. 670), and in Douglas, September 22 (no. 685).

STENOPHYLLUS FLORIDANUS Britton; Nash, Bull. Torr. Club, **22**: 161. 1895

I collected this species in a sandy cornfield in the southeastern part of Sumter county, about two miles from the Flint River, September 10 (no. 622), and in similar situations in Douglas, September 22 (no. 691). It has been known hitherto only from the original station, Eustis, Fla., where Mr. Nash discovered it in 1894. It is a common weed in Douglas, and has long been known to the inhabitants there by the name of "water-grass." On asking the origin of this curious name I was told that it is derived from the fact that the plant is especially abundant after a wet summer.

STENOPHYLLUS CILIATIFOLIUS (Ell.) Mohr, Bull. Torr. Club, **24**: 22. 1897

What is probably this species was collected in dry pine barrens, Dooly county, September 3 (no. 575), and on dry sand

hills near Seventeen Mile Creek in Coffee county, September 24 (no. 696). Both localities are on the Columbia formation, where I have never seen *S. capillaris*. I have been unable to distinguish satisfactorily between *S. ciliatifolius* and *S. coarctatus* (*Scirpus coarctatus* Ell.), but to whichever my plants belong, they are certainly distinct from *S. capillaris*.

RHYNCHOSPORA ALBA MACRA Clarke; Britton, Trans. N. Y. Acad. Sci. **11**: 88. 1892

Collected in a wet sloping bog in Coffee county, September 25 (no. 716), with *Sagittaria Mohrii*. Not previously known from Georgia.

Rhynchospora solitaria sp. nov.

Probably annual. Stems solitary, 5–6 dm. tall, very slender, flattened: basal leaves few, about half the length of the stem and 3 mm. wide, flat or nearly so, weak; upper stem-leaves 2 or sometimes 1: when 2 (as in most of my specimens) the uppermost is short, setaceous, inserted 4–6 cm. below the inflorescence, the other about 20 cm. below the inflorescence, 4–6 cm. long, and as wide as the basal leaves (when only one stem-leaf is present it is intermediate in character and position between the two just described); spikelets lanceolate in outline, 1-flowered, 5–6 mm. long, aggregated in a single dense terminal compound capitate corymb 12–15 mm. broad, with filiform bracts slightly exceeding the inflorescence: achene oblong, compressed, faintly pitted, 1.5 mm. long, capped with a triangular tubercle about a third its length: style exceeding the spikelet, 2-cleft less than half its length, its branches recurved: bristles about 6, very fragile, equalling the achene, very minutely hispid upward.

A species apparently without close affinity to any other of which I have any knowledge. Readily distinguished by its solitary slender culms, flat basal leaves, short upper leaves, terminal inflorescence, and narrow spikelets. Resembles most in general appearance *R. pallida* M. A. Curtis, but that is a stouter cespitose plant with the very different achene and bristles.

Collected in moist pine barrens, Tifton, Berrien county, on Sept. 19 (no. 668), altitude about 340 ft. An inconspicuous plant, growing scattered among the grass, with *Burmannia capitata* and *Sarracenia psittacina*.

The specific name used has a double significance, applying to both the solitary culms and the solitary inflorescence.

ARISAEMA QUINATUM (Nutt.) Schott

A. polymorphum (Buckl.) Chapm.

In rich shady woods (Knox Dolomite formation) in Whitfield county, at 750 ft. altitude, July 18 (no. 253).

HETERANTHERA RENIFORMIS R. & P.

Collected in a wet meadow in Lafayette, at 925 ft., August 2 (no. 345), and in a similar locality along Bear Creek, Whitfield county, at 725 ft., August 7 (no. 376), the latter specimens in flower.

JUNCUS SETACEUS Rostk.

Found in June in two or three localities in Clarke county (nos. 2, 28), and on July 21 on dripping sandstone (Red Mountain) cliffs on the east slope of Rocky Face Mountain in Whitfield county at an altitude of 1400 ft. (no. 280). The latter station is rather remarkable, as the usual habitat of this species is said to be near the coast.

JUNCUS GEORGIANUS Coville ; Small, Bull. Torr. Club, **22** : 44. 1895

On July 10 I collected this species near its type locality, at the northwestern base of Stone Mountain, at about 1100 ft. altitude (nos. 170, 171), and four days later I discovered a second station in Clayton county, 21 miles away, where it grows on flat granite rocks with *Diamorpha pusilla* as at the original station, at an altitude of 950 ft.

JUNCUS DIFFUSSISIMUS Buckley

Collected in muddy places along a road in the western part of Whitfield county, at 975 ft. altitude, July 27 (no. 313). This station is within a few rods of the divide between the Tennessee and Alabama Rivers. This is a western species, and has not been previously reported from Georgia. I am indebted to Mr. Coville for determining my specimens, which are a little smaller than the average.

TRILLIUM UNDERWOODII Small, Bull. Torr. Club, **24** : 172. 1897

Collected by Mr. Wilson in rich shady woods, Whitfield county at 750 ft. altitude, July 18 (no. 69).

BURMANNIA BIFLORA L.

In moist pine barrens, Sumter county, with *Lycopodium alopecuroides* and *L. pinnatum*, September 8 (no. 615). Not previously reported so far inland.

BURMANNIA CAPITATA (Walt.) Mart.

Collected in moist pine barrens, Tifton, September 19 (no. 669), and seen in similar situations in Coffee county, September 21st. Tifton is probably considerably higher than any other known station for this species (340 ft.). The only specimens I have seen besides my own are from Florida and southern Mississippi.

PONTHIEVA GLANDULOSA (Sims) R. Br.

A few specimens of this rare orchid, without flowers, were collected in rich damp woods in the southeastern part of Sumter county, August 25th (no. 489). Not previously reported from Georgia.

HEXALECTRIS APHYLLUS (Nutt.) Raf.

Collected by myself on the southwest slope of Kennesaw Mountain, at 1400 ft., July 12 (no. 225), and by Mr. Wilson at the base of Mt. Rachel (Chickamauga formation) in Whitfield county, at 800 ft. altitude, July 23 (no. 109).

BATIS MARITIMA L.

A few specimens observed on the south shore of Tybee Island, September 29. This seems to be the northernmost known station for this species on the Atlantic coast. Dr. Feay reported it * from Ossabaw Island, which is in Bryan county.

ARISTOLOCHIA CONVOLVULACEA Small, Bull. Torr. Club, **24**: 335. 1897

A single sterile specimen of this species was collected in rich damp woods at the eastern base of Taylor's Ridge in Whitfield county, at 1100 ft. altitude, July 26 (no. 309). This seems to be the first specimen collected since the original ones of Dr. Boykin's.

* Oglethorpe Medical and Surgical Journal (Savannah), 3: 173. 1860. The title of this journal is incorrectly given as "Atlanta Medical Journal" in Dr. Britton's List of Local Floras, and was so copied by me in Bull. Torr. Club, **27**: 323. 1900.

ARISTOLOCHIA NASHII Kearney, Bull. Torr. Club, **21**: 485. 1894

Collected in rich woods along Chokee Creek, Sumter county, August 25 (no. 499). The range of this little-known species is thus extended northward about 30 miles, Dr. Small having collected it near Albany. This and the last-mentioned species were identified for me by Dr. Small.

ASARUM SHUTTLEWORTHII Britten & Baker, Jour. Bot. **36**: 98. 1898

Collected by Mr. Wilson in rich damp woods, DeKalb county, at 950 ft. altitude, July 10 (no. 22).

HEPATICA ACUTA (Pursh) Britton

The known range of this species was extended into Georgia by Mr. Wilson, who collected it in a ravine near Gordon Springs, in Whitfield county, at 975 ft. altitude, July 26 (no. 119), and on the eastern slope of Pigeon Mountain, August 1 (no 166).

DELPHINIUM AJACIS L. Sp. Pl. 531. 1753

This species is quite common as an escape in pastures and along roadsides in Athens, although it has not yet been recognized in any of the floras covering this region.

HYDRANGEA CINEREA Small, Bull. Torr. Club, **25**: 148. 1898

Collected in rich woods on the south side of Bear Creek, Whitfield county, July 18 (no. 243). With the typical form were collected some specimens with leaves glabrous beneath, which are apparently indistinguishable from *H. arborescens*.

PHILADELPHUS HIRSUTUS Nutt.

Collected among sandstone rocks along the summit of the Chattoogata Mountains, at 1350–1450 ft. altitude, July 19 and 21 (nos. 267 and 274). Not previously reported from Georgia.

AMORPHA VIRGATA Small, Bull. Torr. Club, **21**: 17. *pl. 171.* 1894

I collected this species at its type-locality on Stone Mountain, July 10 (no. 179), and in a similar locality on Kennesaw Mountain, at 1450 ft. altitude, two days later (no. 226).

GLOTTIDIUM FLORIDANUM (Willd.) DC.

In a previous paper * I mentioned the remarkable woodiness of the stem of this annual plant. On August 28, while in Americus, I collected some specimens of it (no. 525), including some of the largest stems which I could find. A portion of one of these was recently tested in the engineering laboratories of Columbia University, and found to have a tensile strength of 4,135 pounds per square inch. I afterward determined the specific gravity of the wood, exclusive of pith, to be .358. So this is, perhaps, the strongest and heaviest annual wood known. The specimens I collected were in full bloom, and the wood of older plants would probably be still stronger. A radial section of the stem shows numerous medullary rays, and the microscopic structure of the wood is doubtless interesting. It may be of interest to note that this species was much more abundant in Americus last summer than it was in 1897, and it now forms dense thickets along Muckalee Creek many square rods in extent.

I find that this species was first described, with an excellent colored plate, by N. J. Jacquin, under the name of *Robinia vesicaria* (Ic. Plant. Rar. **1**: 15. *pl. 148.* 1781–6; Collectanea, **1**: 105. 1786). The specific name *Floridanum* originated with Willdenow (Sp. Pl. **3**: 1252) in 1803. The name of the species should then be **Glottidium vesicarium.** A variety (*atro-rubrum* Nash) has been described,† but to rename it would be beyond the scope of this paper. Several other synonyms for the species may be found in Watson's Bibliographical Index.

DOLICHOLUS SIMPLICIFOLIUS (Walt.) Vail, Bull. Torr. Club, **26**: 114. 1899

Specimens of this species were collected in Leslie, September 5 (no. 584). Intermingled with the normal simple-leaved form were many specimens with the upper leaves trifoliolate, these being apparently identical with *D. intermedius* (T. & G.) Vail, as described by Miss Vail (*l. c.*, 115). From the manner in which the two forms occur together and vary into each other they can only be regarded as mere forms of the same species. But I

* Bull. Torr. Club, **27**: 429. 1900.

† Bull. Torr. Club, **23**: 101. 1896.

notice that the original description * of the latter calls for "leaves all trifoliolate."

PHASEOLUS SINUATUS Nutt.

Collected in sandy soil near Leslie, August 31 and September 5 (nos. 555 and 592). Not previously reported north of Florida.

XANTHOXYLUM AMERICANUM Mill.

Two or three sterile specimens of this species were collected on the northern slope of Kennesaw Mountain, at 1750 ft. altitude, July 12 (no. 229). It has not to my knowledge been reported from the Southern States before, but I find in the Columbia University Herbarium a specimen similar to mine, collected on Stone Mountain by Dr. Small.

POLYGALA CURTISSII Gray

Collected by myself on a flat granite rock in Athens, June 25 (no. 54), with *Stenophyllus capillaris*, *Talinum teretifolium*, *Arenaria brevifolia*, *Crotonopsis linearis*, *Ilysanthes refracta*, etc., also by Mr. Wilson on Stone Mountain, July 10 (no. 10), in Whitfield county, July 26 (no. 135), and on the summit of Pigeon Mountain, at 2329 ft. altitude, August 1 (no. 177).

It seems therefore that I was mistaken in supposing † that the genus *Polygala* was not represented in middle Georgia; for besides the species just mentioned, I collected *P. verticillata* in DeKalb county (no. 189), and Mr. Wilson *P. polygama* in Cobb county (no. 5).

CROTON MONANTHOGYNUS Michx.

This is a common weed in the Palaeozoic region, but was not observed by us in other parts of the state. I collected it along the road over Bluebird Gap on Pigeon Mountain, at about 1300 ft., August 3 (no. 362), and in the streets of Dalton, August 9 (no. 387).

CROTON ELLIOTTII Chapm.

Grows in dry pine barrens and dry sandy soil near Leslie. Collected September 5 (no. 593). This species seems to be quite rare. The only specimen I have seen besides my own (and the

*T. & G. Fl. N. A. 1 : 285. 1838.

† Bull. Torr. Club, 27: 330. 1900.

only one cited by Mr. A. M. Ferguson in his recent revision of the genus *) is in the herbarium of Columbia University, and was collected at Quincy, Fla., by Dr. Chapman.

STILLINGIA AQUATICA Chapm.

Having noticed the extreme lightness of the wood of this species, I made a determination of its specific gravity. The specimen experimented with was a part of my no. 460, collected in a pine-barren pond near Leslie, Sumter county, August 23. A stem about 2 cm. in diameter, showing five or six annual rings, was dried with the bark on in an ordinary room for about six months. A piece of it was then shaped into a rectangular prism, placed in a drying oven at a temperature of 90° C. for about four hours, and then carefully weighed and measured. Its specific gravity was found to be .2101. Of all known woods, apparently only that of *Leitneria Floridana*, with a specific gravity of .207 (see Trelease in Rep. Mo. Bot. Gard. **6**: 65–90. *pl. 30–44.* 1895) surpasses it in lightness, and that by a very small margin. More careful tests might perhaps even show *Stillingia* to be the lighter of the two.

Stillingia aquatica presents many other interesting peculiarities besides the lightness of its wood. Unlike *Leitneria*, it has a considerable development of heart-wood, and no pith. It is rather short-lived, the specimens at my locality seeming to die at the age of seven or eight years. It has a remarkably small root-system, resembling very much that of an annual plant, and is very easily pulled up from the mud in which it grows.

BERCHEMIA SCANDENS (Hill.) Trel.

Collected on dry partly shaded limestone rocks, at about 1050 ft. altitude, on the eastern slope of Pigeon Mountain, August 3 (no. 360). The finding of this species in such a place was rather unexpected, as its usual habitat is in alluvial swamps of the coastal plain. All my specimens were sterile. *Bumelia lycioides*, a plant of similar distribution, was found by Mr. Wilson a little higher up the mountain, in similar situations (no. 206).

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* Rep. Mo. Bot. Gard. **12**: 57. 16 F. 1901.

HYPERICUM DOLABRIFORME Vent.

The known range of this species was extended southward into Georgia by my discovery of it on flat exposed limestone rocks at the eastern base of Pigeon Mountain, August 3 (no. 359), about 50 feet lower than the *Berchemia* just mentioned. Previously known only from Kentucky and Tennessee.

The prevailing tree in the vicinity of my locality was *Juniperus Virginiana*, which I never saw in such abundance elsewhere in the state; so this may be an extension of the "cedar-glades" of Tennessee, in which Dr. Gattinger finds several other interesting species of *Hypericum*. Mr. T. H. Kearney, Jr., who has collected *H. dolabriforme* in Tennessee, informs me that he has always found it in these cedar-glades.

Viola denticulosa Pollard, sp. nov.*

Acaulescent, 1–2 dm. in height at the flowering season, becoming 3–4 dm. tall in late summer, producing filiform stolons often fully this length: leaves ligulate-lanceolate, the blades equalling or surpassing the petiole, strongly decurrent, acute at apex, the margin from evenly and finely denticulate to subentire, the upper surface sparsely hirsute with slender bristly hairs: scapes mostly shorter than the foliage: flowers white, nearly or quite 2 cm. in diameter, the keel petal alone veined with dark purple or black: sepals lanceolate, scarious-margined, distinctly auriculate at base, about half the length of the petals: capsules angled or prismatic: cleistogamous flowers borne on erect scapes.

The plant is a southern ally of *V. lanceolata*, bearing somewhat the same relation to that species as *V. primulaefolia australis* does to *V. primulaefolia*. The unusual stature of the plant, its peculiar pubescence, denticulate leaves, which are most noticeable in the older specimens, and the comparatively large sepals and petals are the most distinctive diagnostic characters.

For the above description I am indebted to Mr. Charles Louis Pollard, of the U. S. National Herbarium. The specimens on which the description is based are deposited in the National Herbarium.

This species grows in wet woods among the pine barrens in and near Douglas, Coffee county, where I collected the autumnal stoloniferous and fruiting specimens on September 26 (no. 724).

* Published by permission of the Secretary of the Smithsonian Institution.

As it seemed to differ considerably from any known species, I wrote in April to my friend, Prof. J. W. Hendricks, of the Southern Normal Institute at Douglas, directing him to one of my localities and asking him to collect some flowering specimens for me. He very kindly did so the same month, securing abundant material with flowers and young fruit. He informs me that the best specimens grew in shallow water or very near it. At the time I collected my specimens the ground, although not covered with water, was very moist.

The plant is very abundant in its particular localities, and all of the numerous individuals which I saw seemed to maintain their characters perfectly. To Mr. Pollard's description I can add a character which is not apparent in herbarium specimens, viz : in the living plant (at least in September) the leaves are usually recurved until their tips touch the ground, somewhat after the manner of *Camptosorus*, as might be expected from their great length and thin texture. Some of the leaves of my largest specimens were fully 5 dm. long when fresh.

Some of the specimens collected by Professor Hendricks showed the long dead petioles of last year's leaves, from which the outer tissue had partly fallen off, exposing a strong whitish central vascular bundle. This peculiarity I have never noticed in any other species of the genus.

OPUNTIA VULGARIS Mill.

On July 12 we found this species on the summit of Kennesaw Mountain, at 1809 ft., which is probably the highest station known for it. Stone Mountain, which has hitherto held the record, is 123 ft. lower. It grows also on the Chattoogata Mountains, which are about 75 miles farther inland, but not quite so high.

RHEXIA ARISTOSA Britton

I collected this little-known species in wet pine barrens in Sumter county on August 23 (no. 466), thus extending its known range southwestward about 250 miles, the only previously known station in the Southern States being Sumter, S. C. My specimens are probably the largest of this species ever collected, showing that it reaches its greatest development in Georgia. It grows about 6

dm. tall, and branches copiously ; and with its shining dark-green leaves and numerous large pink-purple flowers it may be considered the handsomest species of the genus.

SANICULA GREGARIA Bicknell, Bull. Torr. Club, **22**: 354. *pl. 242.* 1895

In rich woods on the south side of Bear Creek, Whitfield county, July 18 (no. 256). Not previously reported from Georgia.

SANICULA SMALLII Bicknell, Bull. Torr. Club, **24**: 578. 1897

Collected in rich woods on the south side of Bobbin Mill Creek, Clarke county, July 4 (no. 143).

ERYNGIUM INTEGRIFOLIUM LUDOVICIANUM (Morong) C. & R. Contr. U. S. Nat. Herb. **7**: 48. 31 D. 1900

Collected in moist places among the pine barrens, Sumter county, August 17 (nos. 415, 422), and in a similar locality in Coffee county, September 25 (no. 709). Also observed on September 19 at Tifton, which is within 20 miles of the two stations cited by Coulter and Rose. Six stations in Georgia for this plant are now known (the other one being mentioned in the third edition of Chapman's Flora).

CICUTA CURTISSII C. & R. Contr. U. S. Nat. Herb. **7**: 97. 31 D. 1900

Collected in the edge of a swamp near the Oconee River in the northern part of Athens, July 2 (no. 121). Also seen in Clayton, Paulding and Walker counties.

STEIRONEMA TONSUM (Wood) Bicknell

Collected in dry soil south of Kennesaw Mountain, at 1000 ft. altitude, July 12 (no. 208). This is probably the southernmost known station for it.

STEIRONEMA TONSUM SIMPLEX Kearney, Bull. Torr. Club, **24**: 571. 1897

Two or three specimens were collected on the summit of

Rocky Face Mountain, Whitfield county, at an altitude of 1600 ft., July 21 (no. 284). Known hitherto only from the original collection (Kearney's no. 831) from Wolf Creek, Tennessee. My specimens have been compared with type-material in the herbarium of the New York Botanical Garden, and also examined by Mr. Kearney himself.

LYSIMACHIA FRASERI Duby

This rare species was collected by Mr. Wilson near the summit of Pigeon Mountain, at about 2050 ft. altitude, on August 1 (no. 185).

LIMONIUM NASHII Small, Bull. Torr. Club, **24**: 491. 1897

Collected on the south shore of Tybee Island, September 29 (no. 748). Hitherto reported only from Florida.

SABBATIA BOYKINII Gray

This handsome and little-known species was collected by Mr. Wilson at several points in the northwestern part of the state, at altitudes ranging from 1000 ft. near Gordon Springs to 1950 ft. on Pigeon Mountain. (Nos. 134, 142, 172.) We also saw it at about 800 ft. in Dalton, and at various altitudes in the Chattoogata Mountains. Messrs. Pollard and Maxon found it about the same time in the adjacent portions of Alabama. It seems to have been collected only a few times before.

VERBENA ANGUSTIFOLIA Michx.

This is another common weed in northwest Georgia which seems to be absent from other parts of the state. It is represented in our collections by Mr. Wilson's no. 161, from the west side of Taylor's Ridge in Walker county, July 31, and by my no. 385, from Dalton, August 9.

CLINOPODIUM NEPETA (L.) Kuntze

The foregoing remarks will apply to this species also. Collected in Dalton, August 9 (no. 384).

Dicerandra odoratissima sp. nov.

Annual. Base of stem enlarged, and, like the larger roots, covered with sinuous longitudinal ridges : stem 2–4 dm. tall, fastigiately branched from the base : leaves opposite, linear, 2–3 cm. long, with a few smaller ones fascicled in their axils : flowers odorous, very short-pedicelled, in 3–5-flowered sessile axillary cymes, becoming crowded toward the summits of the branches, the uppermost opening first : calyx ascending or erect, about 8 mm. long, 13-nerved, somewhat bilabiate, the upper lip rounded and entire or nearly so, the lower of two slender incurved teeth, exceeding the upper ; limb of the calyx white, the remainder green : corolla about twice the length of the calyx, white, sprinkled with numerous minute purple spots ; tube straight, included in the calyx ; upper lip arched, the lower spreading or deflexed, and 3-lobed : stamens 4, the anterior pair longest, but not exceeding the corolla ; anthers purple, 2-celled, with short purple horns : style bifid, slightly exceeding the corolla.

A beautifully distinct species, differing from its two congeners (*D. linearifolia* (Ell.) Benth. and *D. densiflora* Benth.) more than they do from each other, so much so that the generic characters will have to be somewhat modified. Among the characters by which it differs from both are the nearly sessile flowers, white-limbed calyx, white corolla, and included stamens. The odor of the flowers of *D. odoratissima* is peculiar, suggesting that of the insect *Cimex lectularius*, but not unpleasant. I do not remember noticing any such odor connected with *D. linearifolia* when I collected that species a few years ago.

D. odoratissima differs further from *D. linearifolia* in its dense inflorescence and purple anther-horns (yellow in *D. linearifolia*, and perhaps in *D. densiflora* also), and from *D. densiflora* in its linear leaves. Some specimens of *D. densiflora* which I have examined have an enlarged stem-base approaching in size that of *D. odoratissima*, but I have not observed this character in *D. linearifolia*.

Dicerandra odoratissima grows in abundance in dry sunny places on sand-hills (Columbia formation) along the Satilla River and its tributaries in southeastern Georgia, and was observed in full bloom Sept. 20–28, in Coffee, Ware and Pierce counties. My specimens were collected near Seventeen Mile Creek, in Coffee county, on the morning of Sept. 24th (no. 695). At the time I

suspected it to be an undescribed species, and photographed a patch of it. This photograph is reproduced in Fig. 3.

At the type locality *D. odoratissima* is accompanied by such plants as *Stenophyllus ciliatifolius* (no. 696), *Smilax pumila*, *Eriogonum tomentosum*, *Siphonychia Americana* (no. 700), *Chrysobalanus oblongifolius* (no. 698), *Euphorbia cordifolia*, *Trichostema lineare*, *Solidago odora* (no. 699), and *Actinospermum angustifolium* (no. 697). The altitude of the type-locality is unknown, but the altitude of the locality in Pierce county where I last saw the plant is about 100 feet. This species grows in large patches, and its characteristic odor was very noticeable from a moving train as I passed through several of these patches the day I left Douglas.

On examining the material representing the genus *Dicerandra* in the Columbia University Herbarium, I found a fragmentary specimen of what is evidently *D. odoratissima*, collected in Georgia by Capt. LeConte, in 1831. On the same sheet (which bears the stamp of the Torrey Herbarium), was a plant collected in Florida by Dr. Baltzell in 1839, which turns out to be *Conradina puberula* Small,* a recently described species. Both were labeled "*Cerantheria linearifolia* Ell.," apparently in Dr. Torrey's handwriting, Capt. LeConte's specimen doubtless came from somewhere in the same region as mine, as he had a plantation in Liberty county, and most of his Georgia plants were probably collected in that vicinity.

YEATESIA LAETEVIRENS (Buckl.) Small, Bull. Torr. Club, **23**: 410. 1896

Collected in low woods near the Flint River, in Dooly and Sumter counties, September 3 and 10 (nos. 582 and 630). This rare species has been hitherto known in Georgia only from the collections of Dr. Small, who found it near Albany, about 30 miles down the river.

HOUSTONIA ROTUNDIFOLIA Michx.

Collected in dry pine-barrens, Sumter county, August 23 (no. 454), and in dry sand near the Flint River, in Dooly county, September 3 (no. 573). This species has probably not been found farther inland. My Sumter county specimens are the only ones I have seen from the Lafayette formation, all the others in the herbaria which I have examined being from the Columbia.

* Bull. Torr. Club, **25**: 469. 1898.

LONICERA FLAVA Sims.

This rare species was found by Mr. Wilson and myself in several localities in the northern part of the state. I collected it on Stone Mountain (no. 178), Kennesaw Mountain (no. 216), and Pigeon Mountain (no. 330); and Mr. Wilson collected it on the Chattoogata Mountains (no. 75). The altitudes of all these stations are between 1250 and 1400 ft.

VERNONIA FLACCIDIFOLIA Small, Bull. Torr. Club, **25**: 144. 1898

We found this species quite frequent in Whitfield and Walker counties, adjoining Catoosa, in where Dr. Small discovered it in 1895. Mr. Wilson collected it near Dalton (no. 86) and on Pigeon Mountain (no. 174). It grows on various formations, ranging from Chickamauga (Lower Silurian) to Coal Measures (Carboniferous), and ascends to 2000 ft. altitude on Pigeon Mountain.

LACINARIA BOYKINII (T. & G.) Kuntze

This species was collected, apparently for the first time since it was described, by me on the high sandy bank of the Flint River in Sumter county, September 10 (no. 635). The original specimens were collected by Dr. Boykin in the vicinity of Columbus in the early part of the nineteenth century.

The circumstances under which I found it lead me to suspect that it is a hybrid between *L. elegans* and *L. tenuifolia*, both of which grew in abundance in intimate association with it. Although these two species are not very similar, yet *L. Boykinii* appears intermediate between them in all its characters, such as position of leaves, length of peduncles, size and color of involucral bracts, plumosity of pappus, and color of corollas (white in *elegans* and purple in *tenuifolia*). The specimens of *L. Boykinii* were much less abundant than those of either of the other species, and I did not find it at any distance from them. My first impression that it was an undescribed hybrid was so strong that it was a surprise to me to find after my return that my specimens were referable to a described species. They have been compared with the type of *Boykinii* in the Torrey Herbarium. I have no means of knowing whether *L. Boykinii* is associated with the same two species elsewhere, as I know of no other living botanist who has

collected it; but it is not at all improbable that these two species might have accompanied it at the original locality, which is about 80 miles from mine.

ANTENNARIA SOLITARIA Rydb. Bull. Torr. Club, **24**: 304. 1897

A. plantaginifolia var. *monocephala* T. & G.

Collected in rich shady woods at two localities in Clarke county, between 600 and 700 ft. altitude (nos. 37 and 142), also in a ravine at the eastern base of Taylor's Ridge, near Gordon Springs, July 27 (no. 321); also seen in the Chattoogata Mountains. No trace of an inflorescence was observed at either locality, but this species is strikingly distinct, by its leaves and stolons alone, from *A. plantaginifolia*, which grows near it in Clarke county, but in warmer and drier places.

ANTENNARIA CALOPHYLLA Greene, Pittonia, **3**: 347. 1898

Fine large specimens, which seem to belong here, with leafy flowering stems and withered involucres still persistent, were collected in dry rocky places north of Stone Mountain, at 875 ft. altitude, July 10 (no. 202), accompanied by *Arenaria lanuginosa* (Michx.) Rohrb. Some leaves which doubtless belong to the same species were collected up on the northwest slope of the mountain, at 1300 ft. (no. 177). Determined by Mr. Elias Nelson.

POLYMNIA CANADENSIS RADIATA Gray

This showy plant was collected, apparently for the first time in Georgia, on the summits of limestone boulders (Mountain Limestone) in rich woods on the eastern slope of Pigeon Mountain, at 1300 ft. altitude, August 3 (no. 361). It is probably a good species. The rays in my specimens were pure white and fully 2 cm. long.

POLYMNIA LAEVIGATA Beadle, Bot. Gaz. **25**: 278. 1898

A second station for this species was discovered by Mr. Wilson on the east slope of Pigeon Mountain, among sandstone rocks (Coal Measures) at 1500–1550 ft. altitude, August 1 (no. 170). Known hitherto only from the original station, Cowan, Tennessee, which is about 45 miles away.

Baldwinia atropurpurea sp. nov.

Stem furrowed, erect, 6–8 dm. tall, simple or with one or two erect branches: leaves alternate, ascending, linear-spatulate, gradually diminishing in size toward the summit of the stem; the lowest 10–12 cm. long by 3–4 mm. wide: heads 1–3, terminal: ligules of the rays spatulate, 3–4 cm. long, 3–4 mm. wide, 2–3-toothed at the apex, pale yellow: disk-corollas dark purple: pappus, achenes and involucre nearly as in *B. uniflora*.

This species is distinguished at once from *B. uniflora*, its only near relative, by its dark-purple disk, longer and narrower leaves, and usually longer and fewer rays. Its aspect in the field is so different from that of *B. uniflora* that I was not certain of the genus until I examined the achenes several weeks after collecting the specimens. In the living plant the rays are decidedly paler than those of *B. uniflora*, but this character is scarcely apparent in dried specimens.

Collected in moist pine barrens, Tifton, Berrien county, at 340 ft. altitude, about 4:15 p. m. on September 19th (no. 662). Accompanied by such species as *Woodwardia Virginica*, *Eriocaulon decangulare*, *Sarracenia flava* (no. 663), *S. psittacina* (no. 660), *Aeschynomene Virginica*, *Eryngium integrifolium Ludovicianum*, *Oxypolis filiformis* (no. 659), *O. ternata* (no. 666), *Mesosphaerum rugosum*, *Viburnum nudum*, *Coreopsis angustifolia* (no. 661), and *Mesadenia lanceolata* (no. 664), which is rather a different association from that in which I have found *B. uniflora*.

I find no specimens similar to mine in the U. S. National Herbarium or the herbaria of Columbia University and the New York Botanical Garden; but it is possible that this species has been collected before. Dr. Chapman, in his Flora, under the head of *B. uniflora*, says: "Dr. Curtis finds a form with the disk flowers dark purple," and this would seem to indicate the occurrence of this species in North Carolina. It should be looked for in the coastal plain of that state, as well as in South Carolina.

Rafinesque has described a *Baldwinia bicolor*,* "found by Le Conte in Florida or Georgia," which I thought at first from his specific name might be my plant; but certain clauses in his description, such as "with white rays and yellow disk" and "stem pedal, leaves uncial," would seem to exclude my *B. atropurpurea*,

*New Fl. N. A. 4: 73. 1836.

so that unless a specimen of Rafinesque's plant is found, it must continue to be classed among his numerous unidentified species.

The nomenclature of this genus is in a somewhat unsettled condition (see Barnhart in Bull. Torr. Club, **24**: 411), but I have used the generic name which will be best understood until a suitable substitute is found. I would hardly regard *Baldwinia* as congeneric with *Actinospermum*, as has been done by some authors.

ACTINOSPERMUM ANGUSTIFOLIUM (Pursh) Torr.

Collected on dry sand-hills near Seventeen Mile Creek, Coffee county, September 24 (no. 697), and observed in similar situations near the Satilla River in Ware county, September 28. Accompanied by *Diecrandra odoratissima* at both stations.

HELENIUM TENUIFOLIUM Nutt.

The spread of this weed in northwest Georgia during the past few years has been remarkable. While in Dalton I was asked by many people if I had noticed how it had taken the place of the dog-fennel (*Anthemis Cotula*), which was as abundant when I lived there, ten or twelve years ago, as *Helenium* is now. Some thought that the *Anthemis* had all changed into *Helenium* by some sort of metamorphosis. *Anthemis* has now almost disappeared from the vicinity of Dalton, while *Helenium* is everywhere in vacant lots and along roadsides. The latter is represented in our collection by Mr. Wilson's no. 88, from Dalton, July 20th. I do not recall another case of an American weed driving out a European one.

Helenium is also common in middle and south Georgia, but does not seem to have perceptibly increased in those sections since 1895, when I first became acquainted with it.

LACTUCA SCARIOLA L.

This weed seems to be obtaining a foothold in Georgia. I collected it in Athens July 2 (no. 122), and afterward saw it in Floyd and Whitfield counties. So far I have seen it only along railroad tracks.

Besides the species here mentioned, there are several others in my collection of 1900 which appear to be undescribed, but as they seem to present more difficulties than those herein described, they are reserved for further study.

COLUMBIA UNIVERSITY.

Studies in the Asclepiadaceae.—V. A New Species of Vincetoxicum from Chihuahua

By Anna Murray Vail

(With Plate 30)

Vincetoxicum Wootonii

(*Gonolobus* A. Gray, non Michaux)

A low branching perennial herb with small axillary subumbellate clusters of dull greenish-purple flowers : stems angled, puberulent with short, apparently twisted hairs : leaves opposite, on petioles 3–5 mm. long ; blades 7 mm.–1 cm. long, pale grayish-green, round-ovate, obtuse at the apex, cordate, the basal lobes rounded, obtuse, thick and coriaceous, glabrous above, puberulent on the veins beneath, ciliate : peduncles 5–12 or 15 mm. long, 3–6- or 7-flowered, puberulent : pedicels very slender, 4–6 mm. long, puberulent, bracteolate at base : calyx-segments ovate-lanceolate, less than 2 mm. long, acute, puberulent, purplish, eglandulose at the base within : corolla-segments rotately spreading, dull yellowish-green, thickish, less than 4 mm. long, oblong-ovate, obtuse, glabrous, vertically reticulated, subglobose? in bud : corona saucer-shaped, 5-lobed, somewhat higher than the anthers, fleshy ; lobes broadly rounded, thickened at the center on the inner side, appendaged with 5 ligulate *Asclepias*-like incurved horns which adhere to the lobe to near the middle : stigma flat, barely 5-angled : pollinia obliquely semi-orbicular ; caudicles broadly winged, very slender at the attachment to the narrowly oblong corpuscle.

Nearly related to *Vincetoxicum biflorum* (Raf.) Heller and remarkable for the small leaves and *Asclepias*-like horns.

Mexico: State of Chihuahua, Colonia Garcia, Sierra Madre, altitude about 7200 ft., collected by Elmer O. Wooton, no. 13, June, 1899.

Explanation of Plate 30

Fig. 1. *Vincetoxicum Wootonii*, slightly reduced.
Fig. 2. Flower diagrammatically enlarged, × 5.
Fig. 3. Flower enlarged, × 2½.
Fig. 4. Corona diagrammatically enlarged.
Fig. 5. Pollinia enlarged, × 50.

Proceedings of the Club

TUESDAY, MAY 14, 1901

The meeting was held at the museum of the New York Botanical Garden, with Dr. Rusby in the chair. Twenty-seven persons were present.

Two new members were elected: Miss Heloise F. Esterly, Inwood, New York City; Dr. Wm. A. Murrill, 232 W. 114th Street.

Five resignations were accepted, of Mr. Wm. L. Fisher, 4670 Lake Avenue, Chicago; Miss Mary Appleton, Riverdale; Miss Beatrix Jones, 21 E. 11th Street; Dr. Clarence C. Howard, 57 W. 51st Street; Mr. A. Emil Schmidt, 448 E. 59th Street.

On vote of the Club the Treasurer was requested to furnish at the next meeting a list of all members delinquent in dues and of the amounts due.

Dr. Britton announced the next meeting of the Horticultural Society on the 11th of June at the Botanical Garden, at 2 P. M., to be devoted particularly to a rose, paeonia and spiraea exhibit. He also extended the invitation of that Society to members of the Torrey Club to be present at that and any subsequent meetings.

Dr. Schoeney, of the Committee on Field Meetings, spoke in favor of making out and printing field programs for the entire summer at one time. Voted to authorize committee to take this course at their discretion.

A letter was read from Mrs. Josephine D. Lowe, of Noroton, Connecticut, inviting the Club to make one of its field excursions to Noroton and vicinity. The invitation was accepted for the second Saturday in June.

The scientific program was as follows:

Professor Underwood spoke on "The Genus *Pteridium*," the type of which is the widely distributed and well-known *Pteris aquilina* of Linnaeus. It was separated from the genus *Pteris* by Gleditsch in 1751, followed by Scopoli in 1760. The principal generic character distinguishing it from *Pteris* is the presence of a double indusium. Specimens of various species, varieties and

forms were shown, including extremely large specimens of *Pteridium aquilinum* collected by the speaker in southern France.

Three species may be recognized in North America. The first of these is the common and variable *Pteridium aquilinum*, of which the recently described variety *pseudocaudatum* Clute is more or less common from New Jersey southward.

The second species is *P. caudatum* found in the extreme tropical portion of Florida. The third, which occurs in the West Indies, seems to be identical with a species originally described from Brazil, though it has been confused with *Pteris esculenta*, a species originally described from the Society Islands. Species from South Africa, India and the Hawaiian Islands were also mentioned.

Dr. D. T. MacDougal gave an account of "Carpotropic Movements of Flowers," taking his illustrations from plants in bloom at the time. The two classes of movements of flowers are the induced or protective and the developmental or automatic. Of the former, the wild carrot furnishes a good example, its umbels being erect during the day and pendent or inverted at night. The segments of the perianth of the tulip also furnish a good illustration of movements induced by changing conditions of temperature.

Developmental movements, *i. e.*, those due to forces which originate within the plant, are well shown in the inflorescence of *Allium Neapolitanum*. The inflorescence here is nodding when in the bud, but the development of the flowers sends a stimulus to the curved portion of the peduncle, causing it to straighten. In addition, the plant is provided against accident by the fact that each pedicel will bend so as to erect the flower if the peduncle is prevented from straightening. Under normal conditions the pedicels take positions separating the flowers equally. In *Claytonia Virginica*, the buds are nodding, the flowers erect. After fertilization, there is another curvature, more abrupt and nearer the base of the pedicel. In *Streptocarpus*, the flower-stalk is curved and somewhat coiled in the bud, while the open flower is horizontal, bending the stalk at a right angle, and after fertilization, the maturing fruit becomes erect. The movements of the fruit, in many cases at least, are for the better dissemination of the seeds, and the movements of the flower are commonly connected with methods of fertilization. Dr. MacDougal referred also to the curious de-

velopment of the cotyledons in *Streptocarpus*. One of the cotyledons ceases to grow after a time, while the other elongates very much. In one species, this cotyledon remains the only foliage of the plant.

Dr. N. L. Britton gave an account of "An undescribed species of *Stachys*," remarking that many North American species were until a few years ago referred to the *Stachys palustris* of Europe, but have more recently been recognized as distinct. A plant which grows on the sand hills along the beach near New Dorp, Staten Island, is really very different from the European *S. palustris*, and may safely be considered a new species. It has been collected in Michigan by Mr. Farwell and a specimen from Illinois is in the Chapman Herbarium. The species is apparently confined to sandy shores.

E. L. BURGESS,
Secretary.

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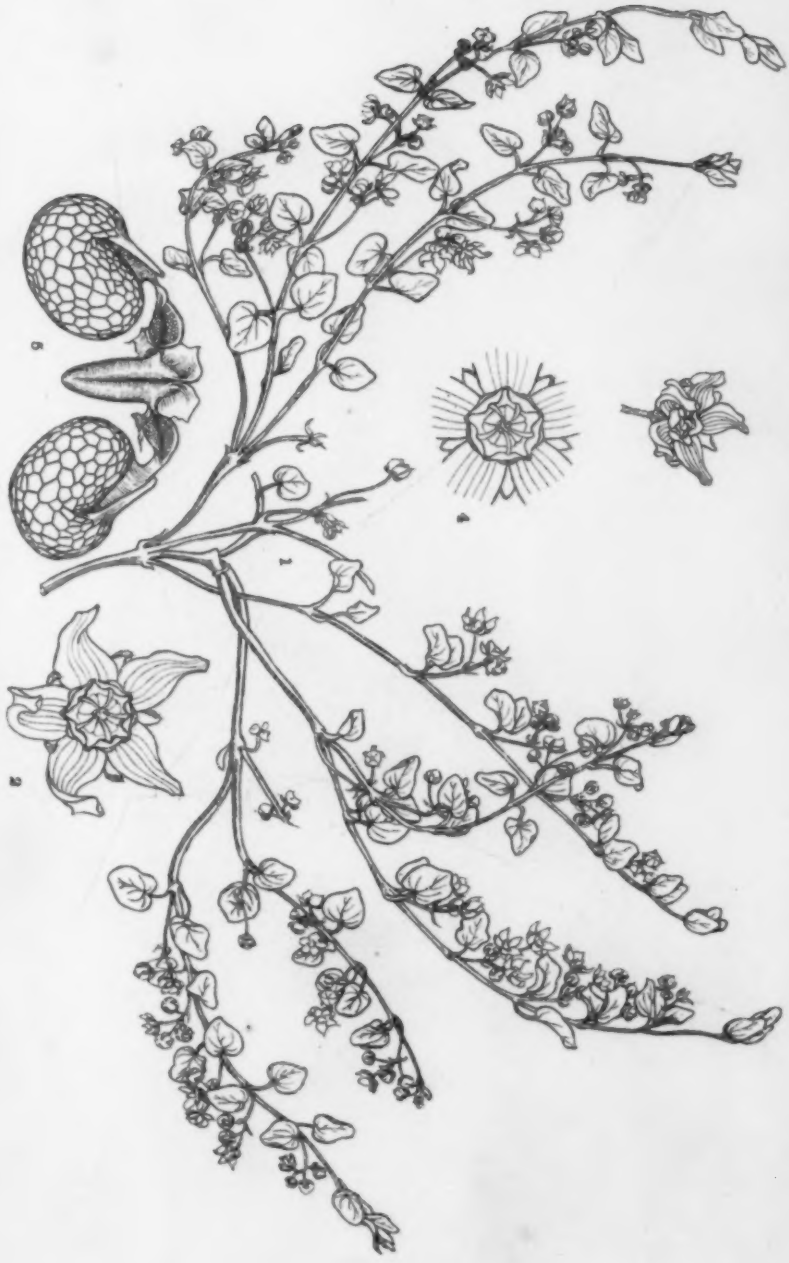
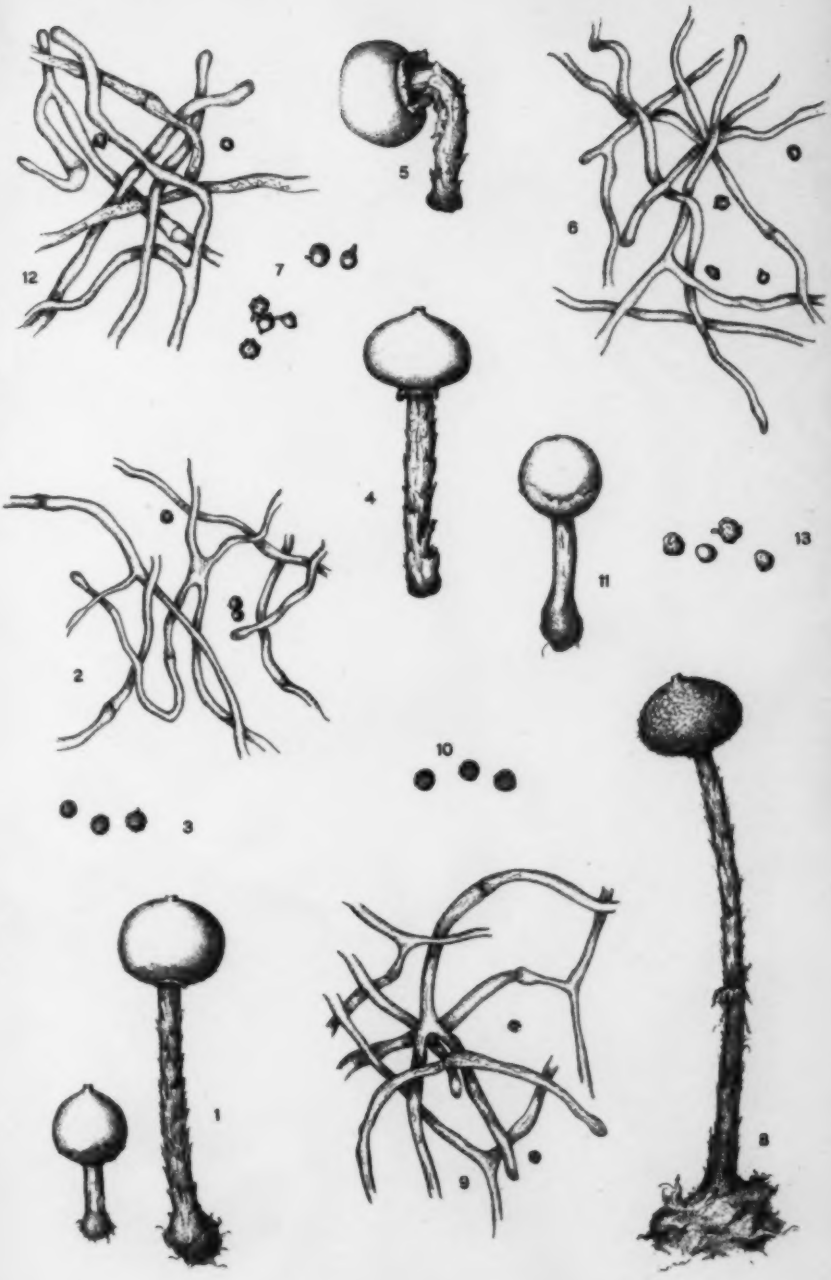
1. STONE MOUNTAIN FROM THE NORTHEAST

2. PINE BARREN NEAR LESLIE, GEORGIA

3. TYPE LOCALITY OF DICERANDRA ODORATISSIMA



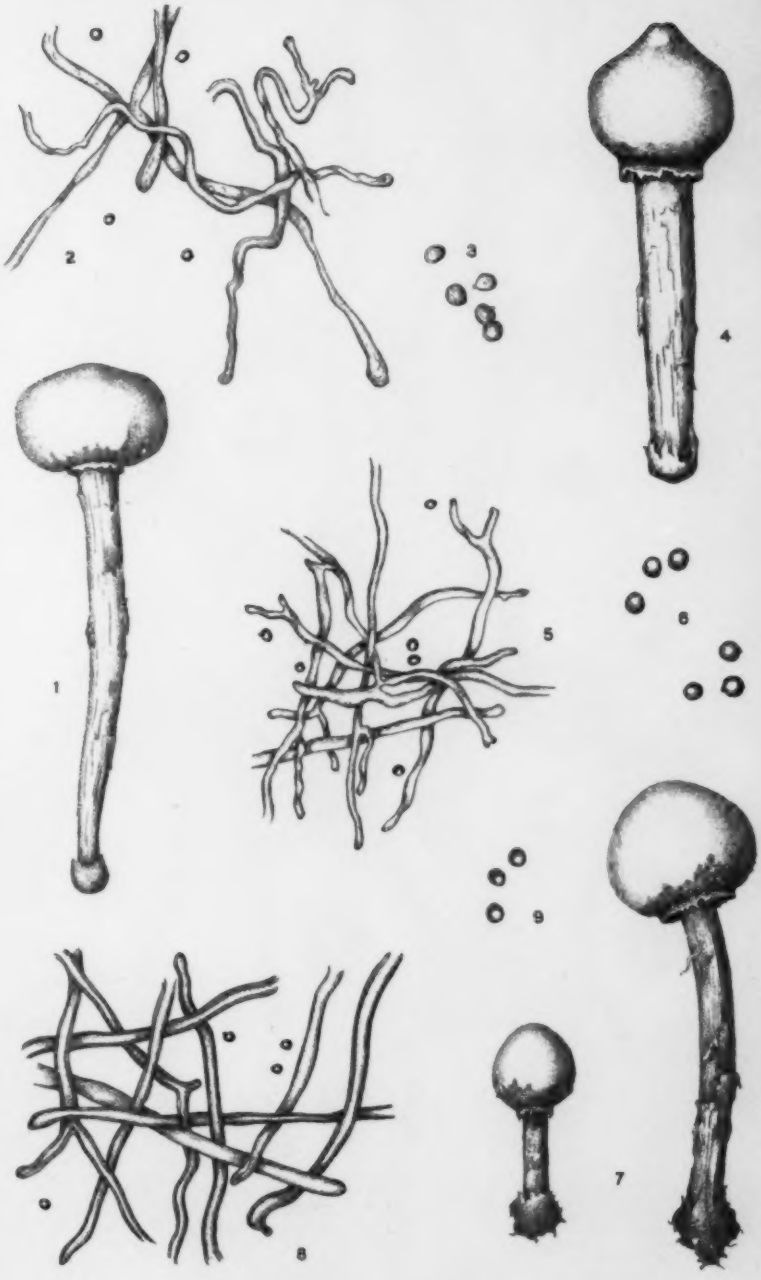
VINCETOSCICUM WOOTONII



V. S. W. Del.

TYLOSTOMA

THE HELIOTYPE PRINTING CO., BOSTON.



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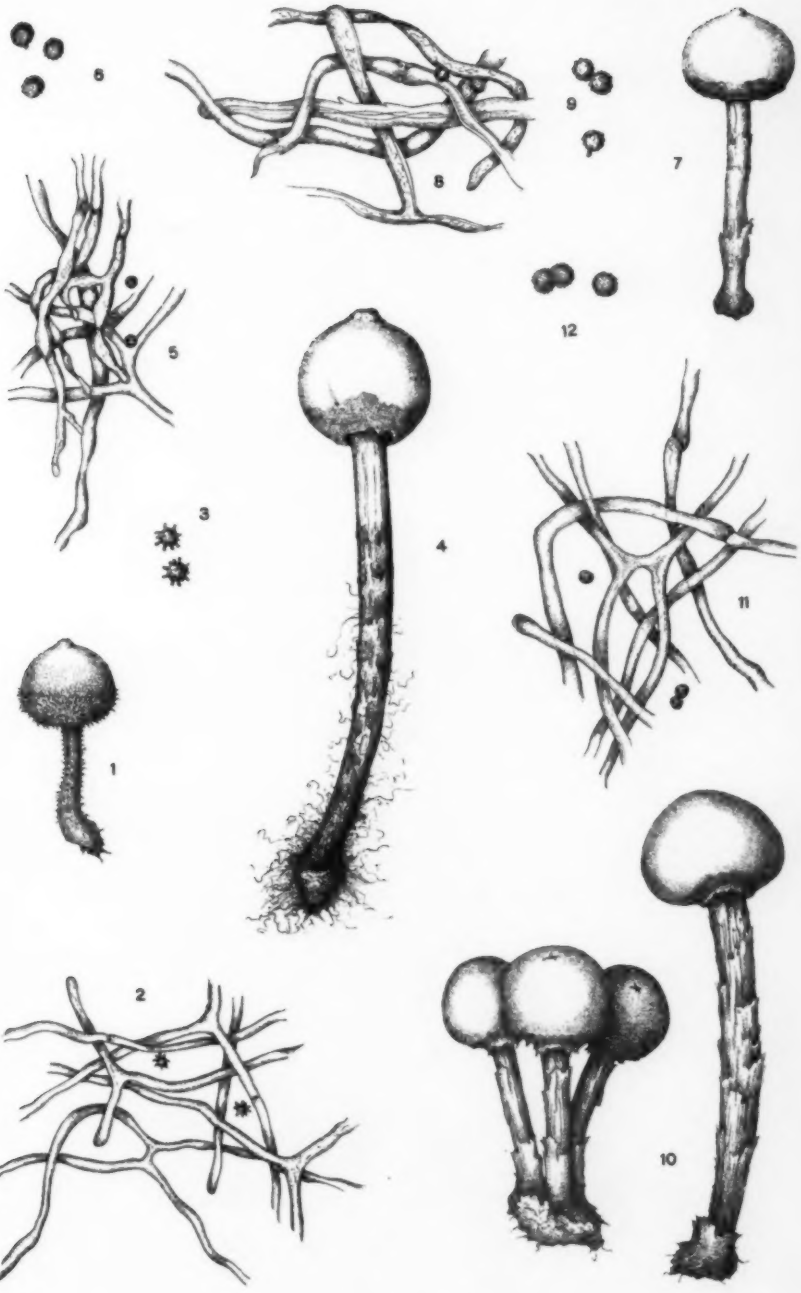

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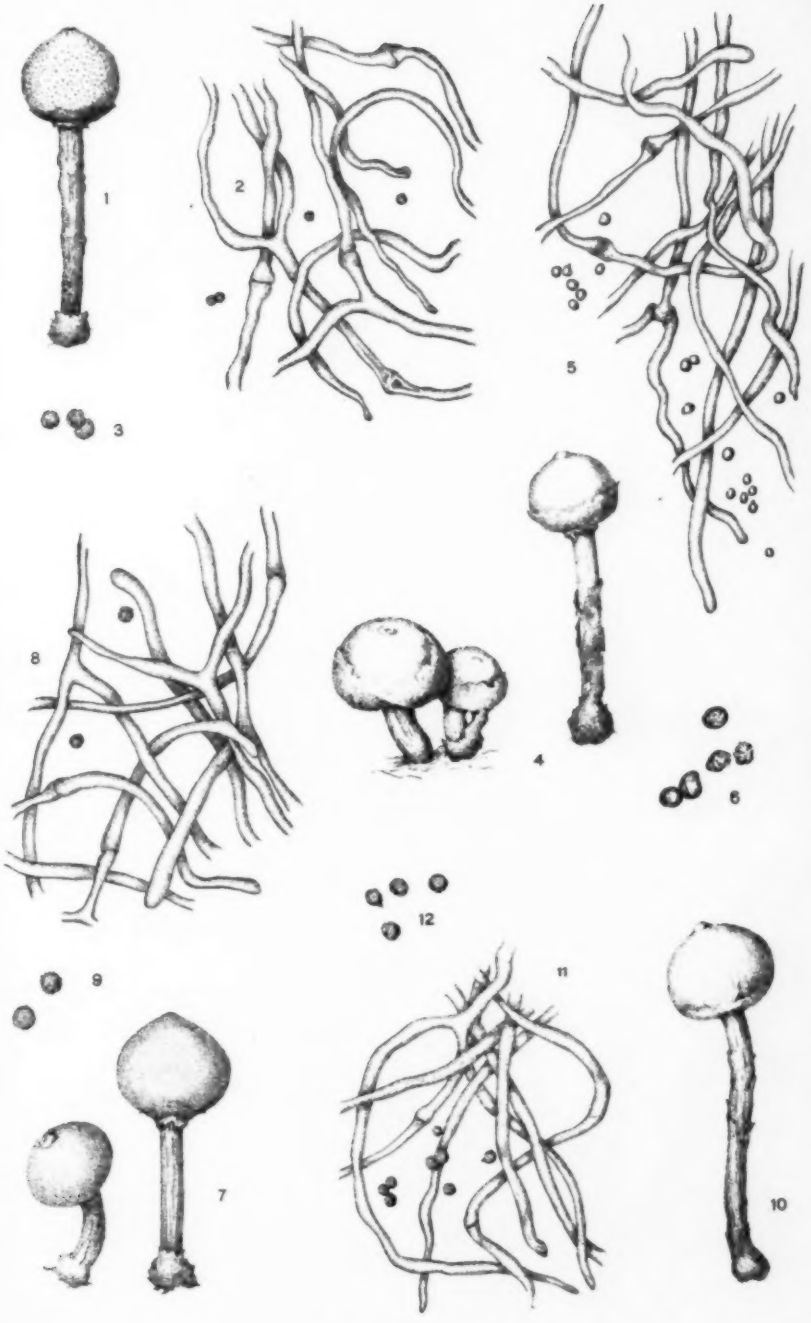

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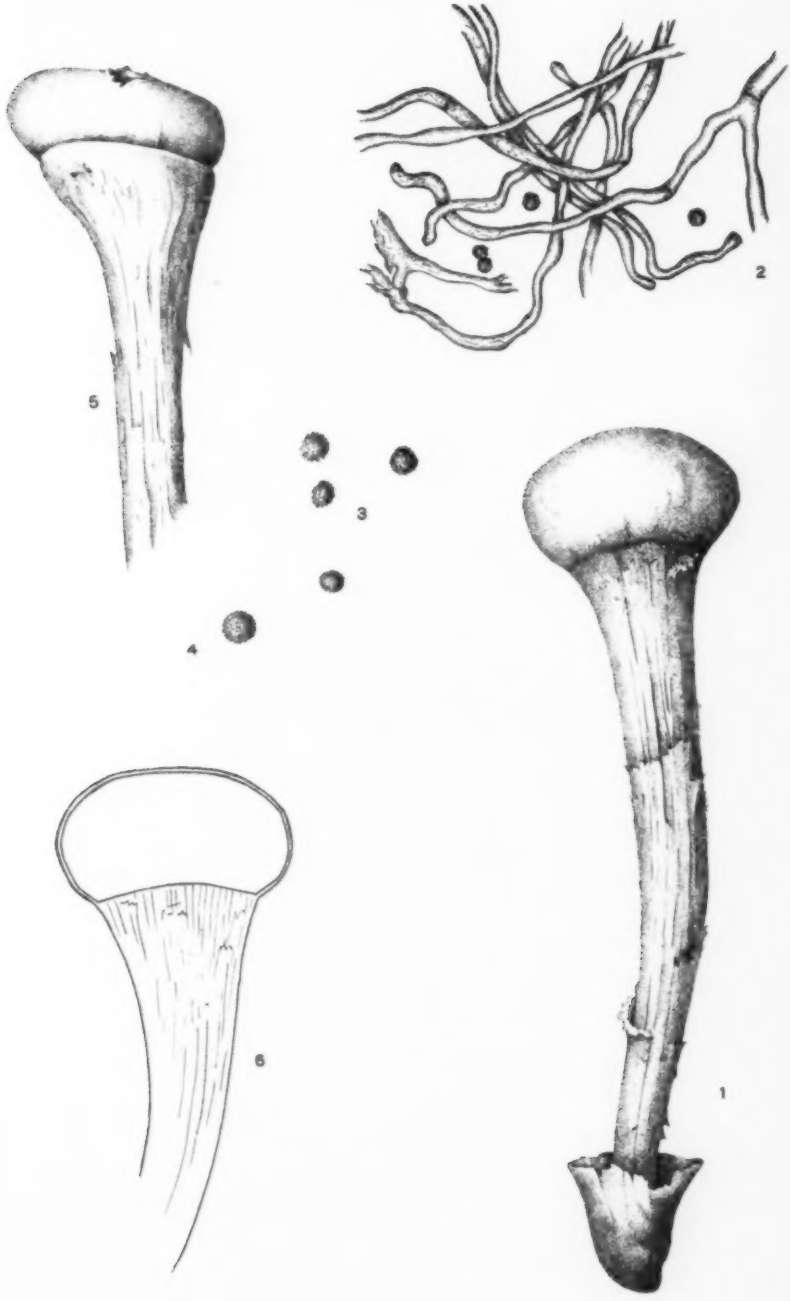

CHLAMYDOPUS

V. S. W. Del.

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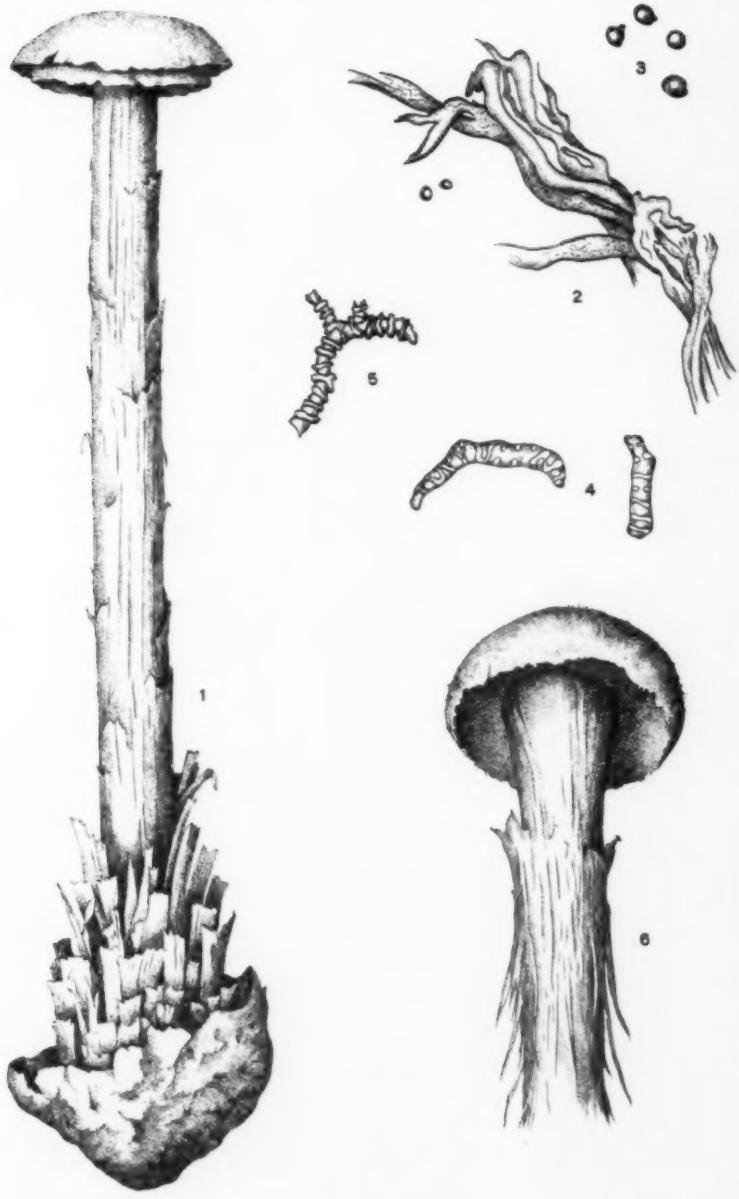

BATTARREA

V. S. W. Del.

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BATTARREA

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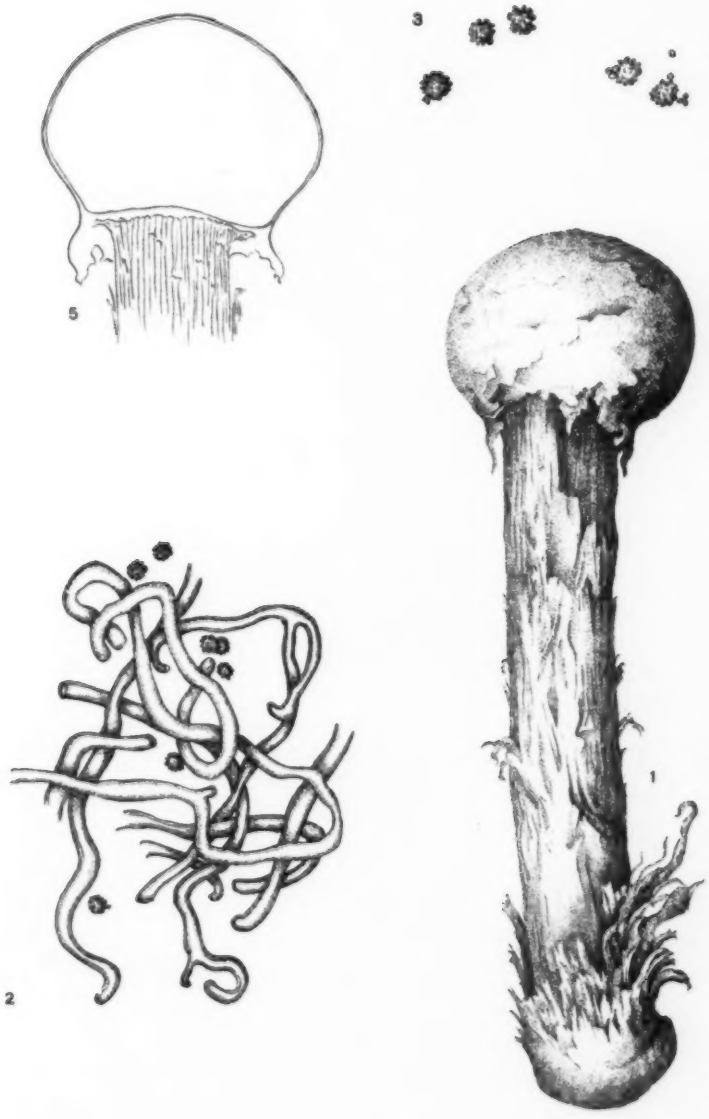

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QUELETIA

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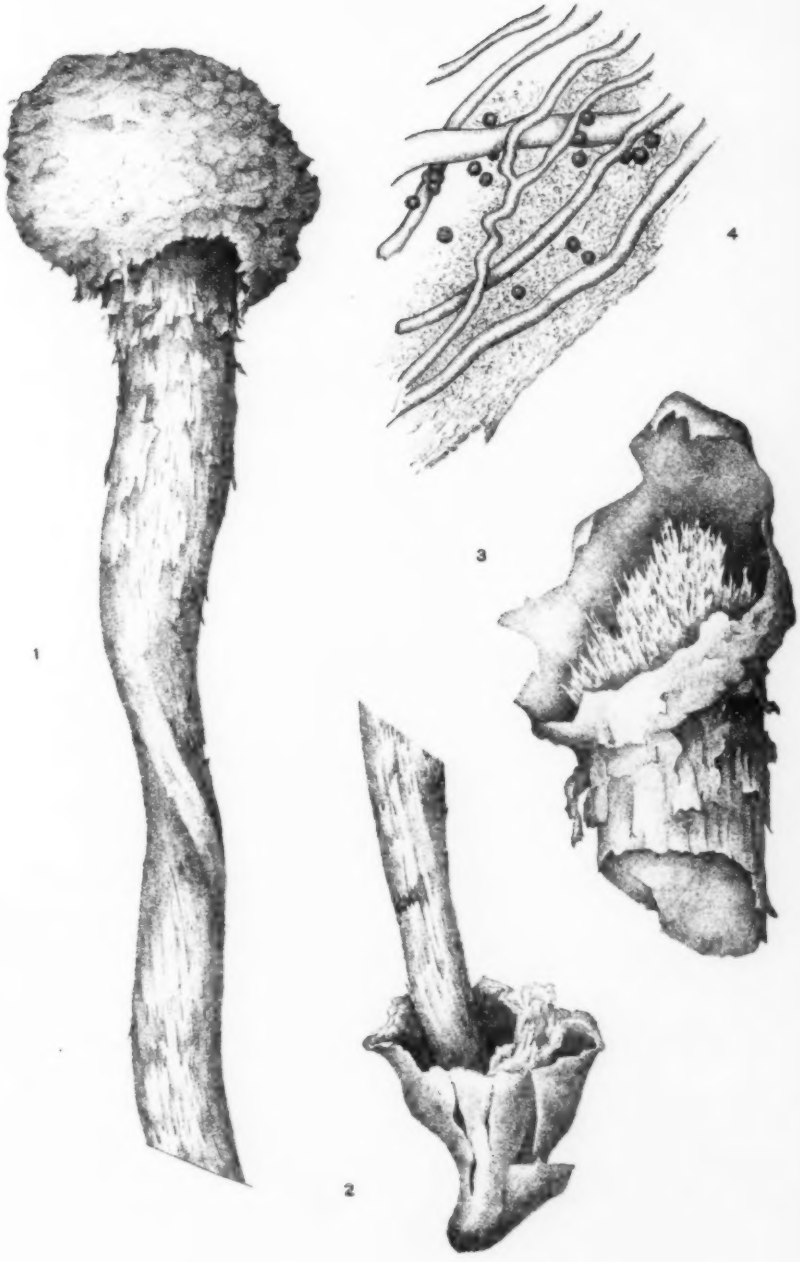

V. S. W. Del.

DICTYOCEPHALOS

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